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Terrorism Networks and Trade: Does the Neighbor Hurt?

José de Sousa
Daniel Mirza
Thierry Verdier.

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TERRORISM NETWORKS AND TRADE: DOES THE NEIGHBOR HURT?

José de Sousa
Daniel Mirza
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NON-TECHNICAL SUMMARY

On 25th of December 2009, a terrorist attempt failed against a plane coming from Amsterdam and about to land in Detroit Airport (Michigan, USA). This attempt has been driven by a Nigerian passenger who appeared to be member of the Al-Qaida's branch in Yemen, Al-Qaida in the Arabian Peninsula. Immediately after the attack, the U.S. authorities strengthened their airports security measures. In particular, they set measures against a list of 14 'countries of interest'.[1]

The aim of this paper is to study the impact of cross-country diffusion of terrorism on security measures and international trade. The last few decades have seen an international expansion of some terrorist organizations. As terrorist threats become global, so are the security measures designed by the targeted countries. For instance, since September 11, the U.S. authorities set some global measures to fight terror (e.g. the Container Security Initiative with 100% scanning of seaport containers, the Customs Trade Partnership Against Terrorism). These global measures are also accompanied by targeted measures, directed against particular areas, such as those being active after the 25th of December. A quick glance at the cross-country difference in the number of U.S. nonimmigrant visas issued to foreign nationals offer an indirect evidence of these measures. In 2002, after the 9/11 attack, almost all of the countries experienced a reduction in visa allowances but some communities have been more affected than others [Cainkar 2004].[2] The Country Reports published by the U.S. State Department on their website reveal another piece of evidence of targeted measures of protection.[3] The day-to-day updated figures provided by U.S. authorities to future travelers out of the US, support the idea that countries hosting terrorist organizations or their cells, should be watched more carefully.

This paper examines the interplay between terrorism diffusion, security policy, and international trade. Many papers investigate the relationship between trade and terrorism [Blomberg and Hess 2006 and Mirza and Verdier 2008 for a survey] or trade and insecurity [Anderson and Marcouiller 1997 and 2002]. Less papers combine trade, security and terrorism. Mirza and Verdier 2006 account theoretically and empirically for the endogeneity between these variables. However, they view terrorism threat as

[1]These are Afghanistan, Algeria, Cuba, Iraq, Iran, Lebanon, Libya, Nigeria, Pakistan, Saudi Arabia, Somalia, Sudan, Syria and Yemen.

[2]On average, Europeans and Asians experienced a 15- and 23-% decrease, respectively. Muslim countries experienced a 40-% decrease with a large variance: from a - 1% for Eritrea to - 67% for Saudi Arabia.

[3]See http://travel.state.gov/travel/.

being confined in one source country at a time. This paper allows instead for terrorism threat to diffuse across countries.

We build a simple theoretical framework of endogenous spatial diffusion of terrorism and security. We then embed this terrorism-security game in a standard new trade theory model. The model predicts 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. In contrast, the model also shows that countries located far enough from terror could benefit instead from an increase in security by trading more.

We employ a large data set of U.S. bilateral imports at the product level and use terrorist incidents against the U.S. to investigate these predictions (ITERATE data). We find three noticeable results on U.S. bilateral imports for the period 1993-2006. First, we find a direct negative impact of terrorism. On average, U.S. imports from the source country of terrorism decrease by about 2 percent for every additional incident perpetrated by this country against the U.S. Second, we find an indirect negative impact resulting from the terrorism of the 'neighboring countries'. The impact is higher, the lower is the distance between the country z and the source country of terrorism. Thus, a one-percent decrease in this distance, decreases bilateral U.S. imports from z by 0.6%. Finally, we document that U.S. imports from 'safe' countries, located far from the source country, increases. These results appear to be robust to various definitions of the distance to the source country.

ABSTRACT

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. In contrast, we demonstrate that 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 neighboring relationships among countries.

JEL Classification: F12, F13
Keywords: Terrorism, trade, security

RÉSEAUX TERRORISTES ET COMMERCE INTERNATIONAL: LE VOISINAGE COMPTE-IL?

José de Sousa
Daniel Mirza
Thierry Verdier.

RÉSUME NON TECHNIQUE

Le 25 décembre 2009, une tentative d'attentat contre un avion en provenance d'Amsterdam et à direction de Détroit aux États Unis a été déjoué. De sources officielles, cet attentat était conduit par un nigérian membre de la branche d'Al-Qaida au Yemen. Aussitôt, les autorités américaines ont réagi en accroissant la sécurité dans leurs aéroports. En particulier, ils ont annoncé des mesures très contraignantes envers les ressortissants d'une liste de 14 pays.[1].

Ces contraintes font écho aux mesures sécuritaires prises jusqu'alors par les États-Unis. Certaines mesures sont de nature globale, comme la radiographie de 100% des containers de marchandises à destination des ports américains. Un rapide aperçu des données concernant le nombre de visas non immigrés délivrés par les États-Unis révèle des mesures plus ciblées. En effet, après les attaques du 11 septembre 2001, certaines communautés demandant des visas d'entrée aux États-Unis ont été plus affectées que d'autres [Cainkar 2004].[2]

Cet article examine les interactions entre la diffusion du terrorisme, la politique sécuritaire et le commerce international. Plusieurs auteurs se sont intéressés à la relation entre commerce et terrorisme [voir Blomberg et Hess 2006 ou le survey de Mirza et Verdier 2008], ou à la relation entre commerce et insécurité [Anderson et Marcouiller 1997 et 2002]. Toutefois, il existe encore peu de travaux sur la relation entre terrorisme transnational, politique sécuritaire et commerce international. Mirza et Verdier (2006) étudient théoriquement et empiriquement l'endogénéité existant entre ces variables. Mais ces auteurs considèrent le terrorisme comme émanant d'un pays à la fois. Le travail présenté ici tient compte de la mobilité internationale des organisations terroristes.

Nous construisons un cadre théorique qui appréhende à la fois la diffusion endogène du terrorisme et la réaction des politiques anti-terroristes. Ce cadre est ensuite inséré dans un modèle plus général de la nouvelle théorie du commerce international. Le modèle prédit que le commerce d'un pays est d'autant plus affecté que celui-ci est proche d'une source terroriste localisée dans un autre pays. Cette prédiction tient à l'hypothèse selon laquelle les mesures anti-terroristes sont aussi bien dirigées contre les pays hôtes des organisations terroristes qu'envers les pays pouvant potentiellement accueillir des branches

[1]Ces pays sont l'Afghanistan, l'Algérie, l'Arabie Saoudite, Cuba, l'Iraq, l'Iran, le Liban, la Libye, le Nigéria, le Pakistan, la Somalie, le Soudan, la Syrie et le Yémen.

[2]En moyenne, alors que la baisse du nombre de visas attribuée aux Européens et Asiatiques a été de 15 et 23% respectivement, les visas accordés aux ressortissants des États musulmans ont baissé de près de 40%.

de ces organisations. Par ricochet, nous montrons que les pays suffisamment éloignés des sources du terrorisme international accroissent en revanche leurs parts de marchés à l'exportation.
Afin d'évaluer la pertinence empirique de ces résultats théoriques, nous apparions une importante base de données sur les importations américaines au niveau produit avec des données de la base ITERATE sur les incidents terroristes menés contre les États-Unis. Nous obtenons trois résultats importants : en premier lieu, le terrorisme issu d'un pays a un effet négatif et *direct* sur son commerce avec les États-Unis. Deuxièmement, ce terrorisme provoque un effet négatif *indirect* sur le commerce avec les États-Unis de ses pays voisins . Enfin, cet effet indirect sur le commerce change de signe et devient positif à partir d'une certaine distance à la localisation des attentats terroristes. Ces résultats sont très robustes aux différentes définitions données du concept de voisinage.

RÉSUMÉ COURT

Nous étudions l'impact des réseaux terroristes sur la sécurité et le commerce international. Nous élaborons un modèle théorique simple prédisant que le commerce d'un pays est d'autant plus affecté qu'il est proche d'une source terroriste localisée dans un autre pays. Cette prédiction tient à l'hypothèse selon laquelle les mesures anti-terroristes sont aussi bien dirigées contre les pays hôtes des organisations terroristes qu'envers les pays pouvant potentiellement accueillir des branches de ces organisations. Par ricochet, nous montrons que les pays suffisamment éloignés des sources du terrorisme accroissent leur parts de marchés à l'exportation. Nous estimons ces prédictions et montrons en effet: (1) un impact direct et négatif du terrorisme transnational issu d'un pays sur son commerce, (2) un impact indirect et négatif du terrorisme transnational issu du pays voisin et enfin, (3) un changement de signe de cet effet indirect sur le commerce qui devient positif à partir d'une certaine distance à la localisation des attentats terroristes. Ces résultats sont très robustes aux différentes définitions donnés au concept de voisinage.

Classification JEL : F12, F13
Mots clés : Terrorisme, Commerce international, sécurité

TERRORISM NETWORKS AND TRADE: DOES THE NEIGHBOR HURT?[1]

José de Sousa *
Daniel Mirza†
Thierry Verdier ‡.

1. INTRODUCTION

The last few decades have seen a spatial extension of the terrorist organizations. They attend now areas that are located thousands of miles away their original territory. For instance, Al-Qaeda, originally based in Saudi Arabia, extends its network as far as North Africa.[2] Al-Qaeda's extension is not limited to the Arab World, however. To gain visibility and logistical support, local groups in Non-Arab countries, such as Abu Sayyaf in the Philippines, are increasingly linked to the Al-Qaeda network. Very recently, an Uzbek group, a sort of joint venture of Al-Qaeda and the Taliban, has expanded overseas to implement a terrorist cell in Turkey. The Turkish cell, called the Islamic Jihad Union, aims to recruit nationals and emigrants in European countries for Al-Qaeda's global Jihad [see Steinberg 2008].
The aim of this paper is to 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 by the targeted countries. 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 U.S. This global measure is supposed to affect all exporting countries to the U.S. alike. However, other global measures might have a distortive effect on trade costs. In particular, the Customs Trade Partnership Against Terrorism and the Container Security

[1]This paper has circulated so far with a slightly different title "Terrorism and Trade: Does the Neigbor hurt?". We are grateful to James Anderson, Brock Blomberg, Gregory Hess, Thierry Mayer, Marta Reynal-Querol, Mathias Thoenig for their valuable comments and suggestions. We also wish to thank seminar participants at the CEPR-PSE workshop on "Conflicts, Globalization and Development", U. of Barcelona (EEA), INRA Rennes, U. of Ljubljana (EIIE), U. of Geneva, and U. of Tours for their helpful comments.
*CREM U. Rennes 1 and CES U. Paris 1
†GERCIE-University François Rabelais and GERCIE (Tours, France), CEPII and CIREM (Paris), email: daniel.mirza@univ-tours.fr
‡PSE and CEPR
[2]The Algerian-based Salafist Group for Preaching and Combat (SGPC) and the Libyan-based Islamic Fighting Group have joined 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].

Initiative have been implemented to insure faster customs clearing at the U.S. entry for the safest exporting companies. But those companies, which can bear the costs of the new security measures, are more usually found in developed countries rather than in developing countries.

The global security measures are also accompanied by targeted measures, directed against particular areas. A quick glance at the cross-country differences in the number of U.S. nonimmigrant visas issued to foreign nationals offers an indirect evidence of these measures. In 2002, after the 9/11 attack, almost all of the countries experienced a reduction in visa allowances but some communities have been more affected than others [Cainkar 2004].[1] The Country Reports published by the U.S. State Department on their website reveal another piece of evidence of targeted measures of protection.[2] The day-to-day updated figures provided by U.S. authorities to future travelers out of the US support the idea that countries hosting terrorist organizations or their cells, should be watched more carefully.

This paper examines the interplay between terrorism diffusion, security policy, and international trade. Many papers investigate the relationship between trade and terrorism [Blomberg and Hess 2006 and Mirza and Verdier 2008 for a survey] or trade and insecurity [Anderson and Marcouiller 1997 and 2002]. Less papers combine trade, security and terrorism. Mirza and Verdier 2006 account theoretically and empirically for the endogeneity between these variables. However, they view terrorism threat as being confined in one source country at a time. This paper allows instead for terrorism threat to diffuse across countries.

We build a simple theoretical framework of endogenous spatial diffusion of terrorism and security. We then embed this terrorism-security game in a standard new trade theory model. The structure of the terrorism-security game is fairly simple. The 'headquarter' of a terrorist organization, based in a source country of terrorism, can settle a terrorist cell abroad to launch an attack against a third country, say U. The ability to settle the cell overseas, say in country z, depends on fixed costs that are increasing with distance to the headquarter. In reaction, authorities of the targeted country U can take optimal security measures against the potential country of settlement z, based on expectations about the terrorist's efficiency. From the game between the headquarter and authorities of country U, we obtain that the diffusion of terrorism is conditional upon the distance of z to the headquarter, the terrorist's efficiency and the optimal level of security.

The diffusion of terrorism has implications for trade between U and the potential countries of settlement z. Imposing security measures against people and goods from country z, such as security checks or visa restrictions, are likely to increase trade costs. This implies that the

[1] On average, Europeans and Asians experienced a 15- and 23-% decrease, respectively. Muslim countries experienced a 40-% decrease with a large variance: from a - 1% for Eritrea to - 67% for Saudi Arabia.

[2] See http://travel.state.gov/travel/.

closer a country z to the terrorist headquarter, the higher the level of security directed against z and the lower its trade with U. However, 'safe' countries (i.e. located far enough from the headquarter) could instead increase their trade with U. The logic is very similar to the inward multilateral resistance effect of Anderson and Van Wincoop 2003. Exports of safe countries into U is increased by high barriers to trade (here, high security measures) set against unsafe source countries of terrorism. Empirical analysis employing a large data set of U.S. bilateral imports at the product level and terrorist incidents against the U.S. provides some support for these predictions.

In the theoretical literature on terrorism and trade [Anderson (2008) and Mirza and Verdier (2006)], aggregate trade flows are shown to affect in turn terrorism activity. This is because, a country's openness to trade might shift resources away from informal sectors, increasing the opportunity cost of engaging in terror activities and pushing labor to more formal sectors. We use fine disaggregated trade data to avoid this potential endogeneity. Moreover, we use the United States as the targeted country U for two reasons. First, the U.S. has been the main target of transnational terrorism for the last 40 years, via its representative authorities, its army or its civilians. Since the beginning of the nineties, it has been involved in nearly half of total transnational terrorist incidents.[1] Second, the U.S. is associated with the largest variation across source countries of terrorism.

To investigate empirically the predictions of our model, we lack precise data on the location of the headquarter of terrorist organizations. On the other hand, we have information on the source countries of terrorism, which potentially host a headquarter. Then, given the possible diffusion of terrorism in a county z, we analyze whether trade between z and the U.S. is affected by the distance of z to the source country of terrorism. In particular, the closer the country z to the source country of terrorism, the higher the supported security measures, and the lower is its trade with the U.S.

In the data, we consider a broad interpretation of proximity to terror and two different types of measures. The first type is discrete and linked to sharing some characteristics with the source country of terrorism, such as a border, a language or a religion. We argue that the more characteristics a country shares with that of terrorism, the closer their neighbor relationship. The second type of measure is taken to be continuous and based on the geodesic distance. Here, for each year of observation, we compute closeness to terrorism as the inverse of weighted average distance of a given country to source countries of terrorism against the U.S. This variable has the interesting feature to resemble to that of a market potential variable in the trade literature. It suggests that the closer to the source of incidents a country is, the higher its

[1] Information on terrorists incidents come from the ITERATE data set which reports transnational terrorist incidents [Mickolus *et al.* 2003]. See the data section 6. for details.

potential to host incidents itself.
Using a gravity-type model of trade, we find on the period 1993-2006 three noticeable results on U.S. bilateral imports. First, we reproduce the direct negative impact of terrorism found in the literature. On average, U.S. imports from the source country of terrorism decrease by about 2 percent for every additional incident perpetrated by this country against the U.S. Second, we find that, when defining closeness as sharing all the three characteristics mentioned above with the source country of terror, the spillover impact on one country's trade is almost as large as the direct impact of terror on trade. That is, U.S. imports from one country is reduced by about 1.8 percent for every additional incident perpetrated by terrorist organizations originating from neighborhood countries. Besides, when we consider the continuous variable of closeness to terror we obtain qualitatively the same results. Finally, we also find that the impact is not neutral on sufficiently remote countries from terror. As expected from our theory, and in line with the Anderson and Van Wincoop (2003)'s multilateral resistance effect, we document positive spillovers on trade of safe countries.
The rest of the paper is structured as follows. In section 2., we set a simple theoretical framework of endogenous spatial diffusion of terrorism and security, embedded into a new standard trade model. In section 3., we explain the empirical strategy and present data on terrorism. In section 4., we present the benchmark econometric results and robustness checks. Finally, in section 5., we conclude. (The Appendix 6. reports data details.)

2. A simple model of Trade, Spatial diffusion of Terrorism and Security

In this section we present the basic elements of a simple model of trade, spatial diffusion of transnational terrorism and security. There are three types of countries that are engaged in international trade. First, there is the U.S. (indexed by U) that is the main 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 U.S. (country U). Finally, there is the rest of the world with whom the U.S. is trading (indexed by R).

2.1. Trade

Each country (i.e. 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_k is the number of varieties produced in each country $k \in \{U, z \in [0,1], R\}$. x_{Uk} is country U demand for a variety of country k. All goods produced in k 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_k is the mill price of products made in k and T_{Uk} are the usual iceberg trade costs between U and K. If one unit of good is exported from country k to country U only $1/T_{Uk}$ units are consumed. Trade costs are assumed to depend on geographical distance, trade restrictions and also on security measures (more on this below). As is well known the value of demand by country U from k is given by

$$m_{Uk} = n_{kj} E_U \left[\frac{p_k T_{Uk}}{P_U} \right]^{1-\sigma} \text{ for } k \in \{U, z \in [0,1], R\}, \tag{1}$$

where E_U is the total expenditure of country U.
Labor is the only factor of production in quantity L_k in country $k \in \{U, z \in [0,1], R\}$. In each country, the different varieties are produced under monopolistic competition. 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 for simplicity to be the same across all countries and sectors. Given this, standard mark-up conditions from profit maximization 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 $n_k = L_k/\sigma$. 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 $L_z = L$ for all countries $z \in [0,1]$ and $\mathbf{T}_U$ the vector $\{T_{Uk}\}_{k \in \{U, z \in [0,1], R\}}$ of bilateral iceberg costs. As is well known from this simple model, one gets bilateral imports of country U from country k as proportional to:

$$m_{Uk} = L_k E_U T_{Uk}^{1-\sigma} P_U^{\sigma-1}. \tag{2}$$

2.2. Terrorism and Security

Terrorist behavior and diffusion of terrorism

We assume that at $z = 0$ is located the headquarter of a terrorist organization A (see Figure 1 in Appendix 8.). A is acting like a multinational terrorist network. Thus, in each country $z \in [0, 1]$, A may implement a terrorist cell to gear an attack from z against country U (i.e. the U.S.). 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 multinational terrorist network. However to capture the decentralized organizational feature of the network, we consider that each cell is maximizing her objective function independently from the other cells in the network. The objective function of a particular cell is to get visibility (which helps her capture political or economic rents).[1] More precisely a terrorist cell in country $z \in [0, 1]$ maximizes

$$Max_R \, \Pi \left(R_z, S_z\right) V - \theta R_z, \tag{3}$$

where $\Pi \left(R_z, S_z\right)$ 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 U against z. V is the perceived visibility gain enjoyed by the terrorist cell when terrorism is successful. θ is the marginal resource cost of the terrorist network. As said, it is a specific characteristic of the terrorist network.

We introduce now a spatial dimension. We assume that to implement a cell in country z the terrorist organization 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 (i.e. $F'(z) > 0$, $F(0) = 0$, and $\lim_{z \to 1} F(z) = +\infty$). 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: $Max_{R_z} \left[\Pi \left(R_z, S_z\right) V - \theta R_z\right] \geq F(z)$.

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

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

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 the reaction curve of the terrorist group in

[1] We follow here a rationalist view of transnational terrorism (see Sandler *et al.* 1983).

country z given a certain level of security S_z imposed by country U on z:

$$R'_z = R(S_z, \theta) = \sqrt{\frac{\varphi S_z V}{\theta}} - S_z \text{ for } S_z \leq \overline{S}(z,\theta) = \left[\sqrt{V} - \sqrt{F(z)}\right]^2 \frac{\varphi}{\theta}, \qquad \text{(terror)}$$
$$= 0 \qquad \text{for } S_z > \overline{S}(z,\theta).$$

Equation (terror) takes into account the fact that a terrorist cell is implemented in country z if and only if $Max_{R_z}\left[\Pi\left(R_z, S_z\right)V - \theta R_z\right] \geq F(z)$. The shape of the reaction curve is depicted in Figure 2 (in Appendix 8.). When the security level S_z imposed by country U against country z is below a certain threshold $\overline{S}(z,\theta)$, 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 $\overline{S}(z,\theta)$, there is no transnational terrorism diffusion to country z and $R_z = 0$.

Security behavior by the U.S.

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

$$G_U = LogW_U(\mathbf{T}_U) - E(C),$$

where $E(C)$ is the expected social cost of terrorism in country U. We assume that, because of pervasive problems of asymmetric information, the government of country U, when deciding his security level S_z against country $z \in [0,1]$, does not know the true value of the marginal resource cost θ of the terrorist network. He has beliefs on this parameter summarized by the density function $f(\theta)$ defined on an interval $\left[\underline{\theta}, \overline{\theta}\right]$. Also, the decision 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, $R^e_z(\theta)$,

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

where $E_\theta(.)$ reflects the expectation operator of government of country U on the level of terrorist resource $R^e_z(\theta)$ undertaken in country z.
Security measures $\{S_z\}_{z\in[0,1]}$ against terrorists involve trade costs.[1] Imposing security measures against people and goods from country z are likely to increase transactions costs on trade

[1] In doing so, we neglect the budgetary costs of security measures on the welfare of the U.S. citizen and concen-

flows (e.g. security checks, time delays, restrictions on visa allowances to business people, immigration controls) and we simply pose that

$$T_{Uz} = T(S_z) \text{ with } T'(.) \geq 0,\ T''(.) > 0 \text{ and } T'(0) = 0. \tag{4}$$

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

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

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:

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

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

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

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

$$\frac{L T_{Uz}^{-\sigma}}{\widetilde{T}^{1-\sigma}} \frac{dT_{Uz}}{dS_z} = C\int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{\varphi R_z^e\,(\theta)}{\left[\varphi R_z^e\,(\theta) + S_z\right]^2}\right] f(\theta) d\theta. \tag{5}$$

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

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

trate 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.

The left hand side of equation (5) is the marginal cost $MC(S_z, \widetilde{T})$ of security measures S_z applied against country z. It is simply the marginal distortion cost of imposing security measures on bilateral trade flows between U and z. $MC(S_z, \widetilde{T})$ is increasing in S_z when $T_{Uz}(.)$ is convex enough in S_z. We noted also its dependence on the aggregate trade friction cost index $\widetilde{T}$ 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 U and z. Hence the larger the marginal cost $MC(S_z, \widetilde{T})$ of security measures S_z between U and z.[1] The right hand side of (5) is the marginal benefit $RM(S_z)$ of security measures on the probability of no occurrence of a terrorist act emanating from z. It depends on the beliefs that the government of U has on the amount of resources $R_z^e(\theta)$ spent by a terrorist cell in z. It is easy to see that $RM(S_z)$ is decreasing in S_z.

Equilibrium

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

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

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

$$S^N = Arg \max_S \; W(S, R^N(.)),$$

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

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

$$S^N = Arg \max_S \left[\begin{array}{c} \frac{1}{\sigma-1} Log\left(L_U T_{UU}^{1-\sigma} + L\int_0^1 T_{Uz}^{1-\sigma} dz + L_R T_{UR}^{1-\sigma}\right) \\ -\, C \int_0^1 \left[\int_{\underline{\theta}}^{\theta_z^N} \frac{\varphi R_z^N(\theta)}{\varphi R_z^N(\theta) + S_z} f(\theta) d\theta\right] dz \end{array} \right], \qquad (6)$$

[1] Note that $\widetilde{T}$ is also endogenous in the model as, in turn, it depends on the level of security measures imposed on all countries $z \in [0,1]$ (see equation 4).

$$R_z^N(\theta) = R(S_z^N, \theta) = \frac{1}{\varphi}\left[\sqrt{\frac{\varphi V}{\theta}}\sqrt{S_z^N} - S_z^N\right] \text{ for } \theta < \theta_z^N, \tag{7}$$
$$= 0 \qquad \text{for } \theta \geq \theta_z^N.$$

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

$$\theta_z^N = \widetilde{\theta}\left(S_z^N, z\right),$$

where the threshold function

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

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

For a given threshold θ_z, the first order condition of problem (6) writes as:

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

Substituting (7) we get

$$MC(S_z, \widetilde{T}) = C\int_{\underline{\theta}}^{\theta_z}\left(\frac{\sqrt{\theta}}{\sqrt{\varphi V}}\frac{1}{\sqrt{S_z}} - \frac{\theta}{\varphi V}\right) f(\theta) d\theta. \tag{8}$$

This is illustrated in figure 3a) (in Appendix 8.). The right hand side of (8) 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_z. 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 (8) has a unique solution $S_z = \widetilde{S}(\theta_z, \widetilde{T})$ which is increasing in the threshold θ_z and decreasing in $\widetilde{T}$ and such that $\widetilde{S}(\underline{\theta}, \widetilde{T}) = 0$.

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

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

and

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

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

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

i) For $z \geq \widetilde{z}$, there is no diffusion of terrorism and no security measure applied against country z (i.e. $R_z^N(\theta) = 0\ \forall \theta \in \left[\underline{\theta}, \overline{\theta}\right]$, $\theta_z^N = \underline{\theta}$ and $S_z^N = 0$).

ii) For $z < \widetilde{z}$, there is a unique threshold $\theta_z^N \in]\underline{\theta}, \overline{\theta}]$ such that 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 ressources engaged in country z is:

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

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

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

The characterization of the Bayesian Nash equilibrium is illustrated in Figure 3b) (in Appendix 8.) for $z < \widetilde{z}$. The security curve $S = \widetilde{S}(\theta_z, \widetilde{T})$ is an upward sloping curve of the threshold θ_z. The larger the threshold below which transnational terrorism diffuses, the larger the benefits of security measures imposed by country U against country z. The threshold curve $\theta_z = \widetilde{\theta}\left(S_z, z\right)$ 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 implementation requires indeed a higher level of efficiency (i.e. a lower value of θ). The intersection of these two curves gives a solution $S_z = S(\widetilde{T}, z)$ and $\theta_z = \widetilde{\theta}\left(\widetilde{T}, z\right)$. Inspection shows that $S(\widetilde{T}, z)$ is decreasing in $\widetilde{T}$ while $\widetilde{\theta}\left(\widetilde{T}, z\right)$ is increasing in $\widetilde{T}$. From this, it follows that

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

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

$$\widetilde{T}^{1-\sigma} = H(\widetilde{T}). \tag{9}$$

The left hand side of this equation is a decreasing function of $\widetilde{T}$ (for $\sigma > 1$) going from $+\infty$ to 0 as $\widetilde{T}$ goes from 0 to $+\infty$. As $H(\widetilde{T})$ is an increasing function of $\widetilde{T}$ with $H(0) \geq 0$ and $\lim_{\widetilde{T}\to\infty} H(\widetilde{T}) > 0$, it follows that equation (9) has a unique solution $\widetilde{T}^*$. Substitution gives immediately $S_z^N = S(\widetilde{T}^*, z)$ and $\theta_z^N = \widetilde{\theta}(\widetilde{T}^*, z)$ for $z < \widetilde{z}$.

We can now derive our two main comparative statics:

a) How does distance to the terrorist organization headquarter influences transnational 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 U.S. or a higher sensitivity of the U.S. to terrorism) affects trade flows across countries?

Let us consider the first comparative static. Simple inspection of Figure 3b) shows immediately how the equilibrium outcome varies with distance z to the terrorist organization headquarter.

Proposition 2 *Whenever transnational terrorism diffuses, (i.e. for $z < \widetilde{z}$), 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 headquarter. In other words, as distance z increases the organizational cost to implement a terrorist cell, the

perceived probability of diffusion of transnational terrorist activity decreases. This in turn reduces the level of bilateral security imposed by country U. These two effects are summarized in the first two panels of Figure 4 (in Appendix 8.).
The effect of terrorism diffusion on trade flows between country U and country z is easily deduced from the equation characterizing their bilateral trade:

$$m_{Uz} = \frac{LL_U T(S_z^N)^{1-\sigma}}{(\widetilde{T}^*)^{1-\sigma}}. \tag{10}$$

It is easily verified that:

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

Proposition (3) basically says that transnational terrorism has some local negative spillover effects on bilateral trade (m_{UZ}). The closer the location of country z to the terrorist organization headquarter in 0, the lower is trade between countries U and z. This effect is depicted in the bottom panel of Figure 4.
Consider now the second comparative static, i.e. the effect of an exogenous shock such as an increase in C, the cost of terrorism in country U. As can be seen on (8), this shock will increase the value of bilateral security $S = \widetilde{S}(\theta_z, \widetilde{T})$. It can be shown that the equilibrium value S_z^N will increase for $z < \widetilde{z}$ and remain constant $S_z^N = 0$ for $z \geq \widetilde{z}$. The security function S_z^N rotates around point $z = \widetilde{z}$ (recall that $\widetilde{z}$ is independent from C). In turn, it can be shown that a larger level of security requires a higher level of efficiency (i.e. a lower value of θ). Hence the equilibrium threshold value θ_z^N will decrease for $z < \widetilde{z}$ and remain constant $\theta_z^N = \underline{\theta}$ for $z \geq \widetilde{z}$. These two effects are depicted in in the first two panels of Figure 5 (in Appendix 8.).
Two effects on trade volumes can be distinguished. They are summarized in the bottom panel of Figure 5. First, it can be shown that the increase in security also shifts up the trade friction cost index $\widetilde{T}^*$. Consequently, all countries benefit from a positive (inward) multilateral trade resistance effect that tend to increase their bilateral trade m_{Uz} with country U. On the other hand, countries with $z < \widetilde{z}$ also suffer from increased bilateral security measures which penalize their trade with U. The overall effect will depend on the location of z to the terrorist organization headquarter at $z = 0$. Trade with country U will increase for countries with $z \geq \widetilde{z}$, as they only face the positive multilateral effect. However, countries close to $z = 0$ will face a decrease in their volume of trade with U (i.e. m_{U0} goes down), as such countries are more affected by the negative bilateral effect than the positive multilateral effect of increased security.[1] In other words, for countries z close enough to the terrorist headquarter (i.e.

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

$z \leq \widehat{z} < \widetilde{z}$), their trade with country U is smaller after the shift in C, while for countries further away from U, (i.e. $z > \widehat{z}$) their trade with country U is larger. 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 $z \leq \widehat{z}$ and increases m_{Uz} for countries such that $z \geq \widehat{z}$.*

3. EMPIRICAL ANALYSIS

There is one implication of the model worth noting even though we cannot test due to lack of security data: the level of security of U applied against country z tend to decrease with the distance of z to the headquarter of terrorist organizations. However, we can investigate two other implications related to trade patterns. The model first predicts that the closer the location of country z to the headquarter, the higher the negative spillovers on its trade with country U. However, the model also predicts that 'safe' countries, i.e. located far enough from the headquarter, may instead increase their trade with country U. We will investigate below the empirical validity of these two implications with a large data set of trade relationships and terrorist incidents against the United States on the 1993-2006 period.

3.1. Data description on transnational terrorism

Data on transnational terrorist incidents come from the ITERATE database set-up by Mickolus, Sandler, Murdock and Flemming 2003.[1] ITERATE is an event-based data set that lists all of the incidents in the world that have been reported in the medias since 1968 onwards. It provides information on the date, the country of location of the attack, and the country of first nationality of terrorists and victims. This helps to define the target country and the source country of terrorism.

Target country of terrorism. The country is coded as a target when it represents that of the first nationality of the victims.[2] Nearly 80% of the victims are associated with only one

[1]ITERATE 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."
[2]ITERATE defines victims as "those who are directly affected by the terrorist incident by the loss of property, lives, or liberty."

nationality, which is why one could assign in a relatively confident way only one target country to an incident. We also consider that the target country can be hit at home or abroad. As an illustration, when an U.S. embassy is hit abroad, the U.S. is coded as the target country.

As noted above, we are mainly interested in the incidents where the U.S. has been the main target, via its representative authorities, its army or its civilians anywhere in the world. One of the main reason is that the U.S. is by far the country that is most hit by transnational terrorism attacks since 1968, before France, Israel and Great Britain. Moreover, the distribution of incidents against the U.S. is spread over a large sample of source countries. Having sorted the number of 'bilateral' incidents (i.e. between source and target countries) between 1968 and 2003, Mirza and Verdier 2006 observe that about one third of the top 65 bilateral incidents involve the U.S. as a target country.[1]

Source country of terrorism. The country is coded as a source when it represents that of the first nationality of the attacking force. Three potential issues are here worth mentioning.[2] First, we may be concerned that there is no one first nationality in the attacking group but different equally-sized nationalities. However, as noted by Blomberg and Rosendorff 2009, 98% of incidents are reported with only one source country. Second, the nationality of the attacking force may not represent the view of the country with which it is associated. We abstract from this problem as long as the U.S. implements security measures against a country hosting attacking forces, regardless of the representativeness of the terrorist's views. Moreover, "this problem is no less severe than what we encounter when we try to measure any international variable" (Blomberg and Rosendorff 2009) such as investment or trade. Third, the source country might not be the country of location of the incidents, defined as the place where the incidents have been committed. However, we observe in the data that 96% of the incidents perpetrated against the U.S. have the same source *and* location country.

More generally, 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, the top 10 source countries of terror (i.e. Columbia, Turkey, Iran, Lebanon, Cuba, Spain, Greece, Philippines, Great-Britain and Peru) have perpetrated about 200 incidents each since 1968. The rest of data sources are described in Appendix 6..

[1]This is obviously not the case for Israel, France or Great Britain which are associated with at most 3 countries in the top 65.

[2]It is also worth noting that one third of total incidents have been perpetrated by unknown groups, to which no source have been associated

3.2. Construction of the proximity to terrorism

We unfortunately lack precise data on the location of the headquarter of terrorist organizations. On the other hand, we have information on the source countries of terrorism. Each one potentially hosts a headquarter (or an affiliate) from which it may diffuse terrorism abroad. To analyze empirically the predictions of the theory, we thus consider the source country of terrorism as the country $z = 0$, and call it country i for simplicity. Then, we should give an empirical content to the theoretical concept of distance z between the country i and the country where the terrorist cell can be implemented, called country j for clarity.

Thus, terrorists from country i may implement a terrorist cell in j to launch an attack against the U.S. The closer the country j to country i, the higher the probability to host a cell, the higher the U.S. security measures against j and the higher the negative spillover on its trade with the U.S.

We consider a broad interpretation of the proximity between i and j and use two different types of measure. The first type is continuous and based on the geodesic distance; the second type is discrete and linked to sharing some characteristics among countries i and j, such as a border, a language or a religion. We benefit from both types to check the robustness of our results. We first present the discrete version, and then the continuous one.

Discrete version of proximity to terrorism

Defining a discrete version of proximity to terrorism, we proceed in two steps. We first identify the countries $i = 0, 1, ..., I$ which are neighbors of country j. We use different definitions of the neighborhood concept to test the robustness of our results. These definitions lie on different combinations c of characteristics shared by countries i and j. The characteristics retained are here the common border, the common language and the common religion. As an illustration, consider two different combinations.[1] The first one defines neighboring relationships among countries based on the sharing of a border, a language *and* a religion, i.e. we define a set of dummies $D_1 = \{\text{Contiguity}_{ij}, \text{Language}_{ij}, \text{Religion}_{ij}\}$.[2] Thus, in 1993, Sudan has one neighbor i which hurts the U.S. (namely Egypt) among the three countries with whom it shares a border, a language and a religion (i.e. in our sample: Chad, Egypt and Libya). The second combination is based on the sharing of a border only, i.e. we define a

[1] Using these two alternative combinations, Table 5 in Appendix 7. depicts the distribution of the neighbor relationships among countries in the world.

[2] $\text{Language}_{ij} = 1$ if i and j have a common official (or primary) language, 0 otherwise; $\text{Contiguity}_{ij} = 1$ if i and j share a land border; $\text{Religion}_{ij} = 1$ if i and j share a religion. We consider 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.

set $D_2 = \{\text{Contiguity}_{ij}\}$. In this case, in 1993, Sudan has two neighbors i which hurt the U.S. (namely Egypt and Ethiopia) among its seven contiguous neighbors (i.e. in our sample: Central African Republic, Chad, Democratic Republic of the Congo, Egypt, Ethiopia, Kenya, Libya and Uganda).
In the second step, we construct a variable $discrete\_closeness$ which sums the number of terrorist incidents perpetrated against the U.S. by the neighbor(s) i of a given country j. Formally,

$$\text{discrete\_closeness}^c_{jt} = \sum_{i=1}^{I} \text{Terror}_{it} \times \prod_{d=1}^{D_c} \text{Dummy}^d_{ij}, \quad (11)$$

where c is a given combination of characteristics; Terror_{it} is the number of terrorist incidents perpetrated by the neighbor countries $i = 0, 1, ..., I$ against the U.S. in a year t; Dc is a set of dummy variables d related to the combination of characteristics shared by countries i and j. As an illustration, in 1993, the Sudan's neighbor country i, with whom it shares a border, a language and a religion (see above), perpetrated 4 terrorists incidents against the U.S.
The $discrete\_closeness^c_{jt}$ variable represents a proxy for the distance z to terrorism. First, for a given combination c, the higher the number of terrorist incidents perpetrated by *j*'s neighbor(s), the closer is j to terrorism. Moreover, we argue that the more characteristics j shares with i, the closer their neighbor relationship. Thus, we expect that an additional terrorist incident of the neighbor(s) against the U.S. will be more detrimental for trade when j shares several characteristics with i (e.g. D_1) than only one (e.g. D_2). We will below incorporate the different combinations of $discrete_closeness^c_{jt}$ in the trade specification and estimate this prediction.

Continuous version of proximity to terrorism

Defining a continuous version of proximity to terrorism, we make use of the geodesic distance and construct a $continous\_closeness_{jt}$ variable. Thus, for each year t, we compute the inverse of the weighted geographic distance of a given country j to source countries of terrorism i against the U.S. The weight is the corresponding share of the source country i in the total incidents against the U.S. This inverse measure simplifies the interpretation of the empirical results and allows for a more direct comparison with the estimates of the discrete versions of proximity to terrorism. More formally we compute

$$continuous\_closeness_{jt} = \frac{1}{\sum_i (w_{it}).\text{Geodist}_{ij}},$$

where w_{it} is the share of country i incidents against the U.S. in year t and $Geodist_{ij}$ is the bilateral geodesic distance between country i and country j. This variable has the interesting feature to resemble to that of a market potential variable in the trade literature. It says that the higher the variable, the closer to the source of incidents a country j is, the higher its potential to host incidents itself.

3.3. Trade specification

We rewrite equation (2), derived in the theoretical part, as

$$m_{Uj} = L_j L_U T_{Uj}^{1-\sigma} P_U^{\sigma-1}, \tag{12}$$

where m_{Uj} is an $J \times 1$ vector with row j equal to U.S. imports from country $j \in \{z \in [0, 1], R\}$.[1] Equation (12) defines a gravity-like model of trade. It relates trade between the U.S. and country j to their economic size (L_j and $L_U = E_U$), their bilateral trade costs T_{Uj} and the importing price index P_U. We now fit the equation to the data as follows. First, we discard importing country-variable controls, i.e. U-specific controls, such as economic size and price index. We may discard these variables because in our data set the importing country is always the U.S. and these variables only have time-series variation. We capture such variation by allowing for year specific effects in trade. Second, we proxy the number of workers available for production in the exporting country j, L_j, by the gross domestic product GDP_j. Then, we decompose GDP_j in population (POP_j) and GDP per capita (GDP_j/POP_j), 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 might be correlated both with aggregate bilateral trade and terrorism activities (see above). Fourth, we posit that trade costs (T_{Uj}) are a log-linear function of observables ϕ_{ij}:

$$T_{Uj} = \prod_{m=1}^{M} (\phi_{ij}^m)^{\gamma_m}. \tag{13}$$

Normalizing such that $\phi_{ij}^m = 1$ measures zero trade barriers associated with a given variable m, $(\phi_{ij}^m)^{\gamma_m}$ is equal to one plus the tariff equivalent of trade barriers associated this variable [Anderson and van Wincoop 2004]. As in many empirical applications, the list of observables ϕ_{ij}^m includes the bilateral geodesic distance (Geodist_j) between country U and j, and a dummy variable (in antilog) indicating whether the U.S. shares a language with the exporting country j (Lang_j). Moreover, following our theoretical setting, we consider that trade costs are induced

[1] We abstract here from the U.S. intra-national trade due to data constraints (see Appendix 6.).

by the counter-terrorism measures implemented by the U.S. government. Such measures are largely unobservable but are arguably positively correlated with international terrorism activity. Consequently, we proxy the level of the U.S. security measures against country j by the incidents perpetrated by j (Terror$_j$) and its neighbors ($\mathbf{Neighborterror}_j$) against the U.S. The variable Terror$_j$ simply sums the number of incidents of country j against the U.S. The elements of the vector $\mathbf{Neighborterror}_j$ are the discrete and continuous versions of the distance to terrorism. We also add an error term (ϵ_j) to equation to capture all the unobserved linkages between U and j that affect bilateral trade costs.
Finally, we benefit from the multiplicative form of equation (2) to operate a log-linear transformation of the model. Dropping the country U subscripts for notational convenience while considering countries $j \in \{z \in [0,1], R\}$ that are exporting to the U.S., we obtain the following estimated equation:

$$\begin{aligned} \ln(m_{jst}) &= \ln(POP)_{jt} + \ln(GDP/POP)_{jt} + \alpha_1 \ln(Geodist)_j + \alpha_2(Lang)_j \\ &+ \beta_1(Terror)_{jt} + \beta_2(\mathbf{Neighborterror})_{jt} + \rho_t + \rho_s + \epsilon_j, \end{aligned} \quad (14)$$

where the year and product observed are represented by t's and s' subscripts respectively, m_{jst} express U.S. 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 U.S. country-variable controls; ρ_s denotes product fixed effects; $\alpha_1 = (1-\sigma)\delta$, $\alpha_2 = (1-\sigma)\gamma_1$, $\beta_1 = (1-\sigma)\gamma_3$, 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 terrorist 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 U.S. imports.

4. EMPIRICAL RESULTS

4.1. Benchmark results

We first present the results for the discrete measure of the $\mathbf{Neighborterror}$ vector, then those for the continuous measure.

Discrete version of proximity to terrorism

In Table 1, we report results for equation (14), using different combinations of the discrete measure of distance to terrorism ($discrete\_z^c_{jt}$). All specifications include a full set of year-specific and product-specific (5-digit) dummies. 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 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 U.S. with elasticities close to one as predicted by the model.[1] In line with the literature, the share of the English language increases trade with the U.S. On the other hand, the elasticity of trade to distance is negative but with a lower estimate than in the literature [around a mean elasticity of 0.9; see Disdier and Head 2008].

As expected, we find a negative effect on U.S. imports of terrorist incidents perpetrated by country j against the U.S. In all regressions, the semi-elasticity of Terror is statistically significant. On average, exports to the U.S. decrease by about 2 percent for every additional terrorist incident against the U.S. Is this effect economically significant? What does represent an additional terrorist incident against the U.S.? 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 (1). 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 of terrorist incidents decreases U.S. imports by .016 standard deviation. In absolute value, this magnitude appears to be much lower than the standardized effect of the traditional gravity variables: .475 for population, .394 for GDP per capita, -.115 for distance, and .057 for common English language. These results suggest that an additional terrorist incident leads to an economically significant effect but its occurrence is rare.

Our theory predicts negative local spillovers on imports to the U.S., when close exporter's neighbors hurt the U.S. Empirical results of Table 1 basically confirm this prediction. In all columns, we find negative semi-elasticities of trade to the number of incidents of the exporter's neighbors. Some differences across regressions are worth mentioning, however. For instance, in column (1), we find a negative but statistically insignificant effect when defining neighborhood on a linguistic basis. In contrast, in column (2), we find a significant negative effect: on average exports to the U.S. decrease by 0.6 percent for every additional terrorist incident perpetrated by the exporter's religious neighbors against the U.S. In column (3), we find a slightly larger effect when defining neighborhood on contiguity even though the difference with the estimate of column (2) is not statistically significant. These results are reassuring if we consider

[1] Instead 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.

Table 1 – Trade and distance to terrorism (discrete version)

Dependent variable	ln(U.S. imports)				
	(1)	(2)	(3)	(4)	(5)
Definition of Neighbor terror$_{jt}$	Linguistic	Religious	Contiguous	Contiguous & Linguistic	Contiguous & Linguistic & Religious
ln(Population)$_{jt}$	0.957^a	0.955^a	0.962^a	0.960^a	0.957^a
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
ln(GDP/Pop)$_{jt}$	0.887^a	0.892^a	0.886^a	0.886^a	0.886^a
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
ln(Distance)$_j$	-0.642^a	-0.660^a	-0.636^a	-0.640^a	-0.641^a
	(0.048)	(0.049)	(0.048)	(0.048)	(0.048)
English Language$_j$	0.457^a	0.421^a	0.427^a	0.421^a	0.424^a
	(0.050)	(0.044)	(0.045)	(0.045)	(0.045)
Terror$_{jt}$	-0.019^b	-0.021^b	-0.019^b	-0.019^b	-0.018^b
	(0.009)	(0.008)	(0.009)	(0.009)	(0.009)
Neighbor Terror$_{jt}$	-0.004	-0.006^a	-0.011^a	-0.014^a	-0.017^a
	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)
Fixed Effects:					
Year	yes	yes	yes	yes	yes
Product (5-digit)	yes	yes	yes	yes	yes
Adj. R^2	0.38	0.38	0.38	0.38	0.38
# of Observations	449832	449832	449832	449832	449832

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.

that the U.S. security is discriminatory and regional, i.e. directed against particular geographic areas. A given country $j = z$ could indeed share the language of a country 0 while being geographically far remote from 0, with a low probability to host a terrorist cell. This could explain why the Neighbor Terror estimate is not significant in column (1), when distance to terrorism is only define on a linguistic basis. The ensuing columns (4) and (5) of Table 1 highlight larger semi-elasticities when considering a stricter definition of the neighborhood. Thus, a shorter distance to terrorist incidents appears to induce a bigger negative effect on US imports. It seems in fact reasonable to consider that neighbors are closer when they share a border, a language and a religion (column 5) than only a border (column 3) or only a religion (column 2). These results are thus in line with the theoretical prediction that the closer the location of the exporting country to country 0, the higher the negative local spillover effects on its U.S. trade.

Continuous version of proximity to terrorism

The above discrete measures offer us a comparison between the situations where countries share or not some closeness characteristics. However, the differences of $(\widehat{\beta_2})$ across regressions (3) to (5) are probably not statistically significant despite precise estimates (p<0.01) and different magnitudes. To further investigate the empirical validity of our main theoretical predictions, we use a continuous variable of distance to terrorist incidents $continuous\_z_{jt}$. This variable is computed as the inverse of the weighted average distance of a given country j to source countries of terrorism against the U.S. The result reported in Table 2 shows that a one-percent increase of the closeness to the terrorist incidents decreases U.S. imports by 0.6 percent. This effect is economically and statistically highly significant.

In contrast, we may wonder if ‘safe’ countries (i.e. located far from terror) could benefit, in terms of trade, from an increase in security. To investigate this part of proposition 4, we decompose in column (2), the $continuous\_z_{jt}$ variable in three categories. Each category represents one-third of the observations: the dummy *close to terror* equals one for the closest countries to terror; the dummy *Far from terror* equals one for the farthest countries to terror. The in-between group is omitted and represents the group of comparison. Based on this 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. As noted above, the logic is very similar to the inward multilateral resistance effect of Anderson and Van Wincoop 2003. Exports of safe countries into the U.S. is increased by high barriers to trade (here, high security measures) set against unsafe source countries of terrorism. In contrast, countries close to terror trade less with the U.S.

Table 2 – Trade and proximity to terrorism (continuous version)

Dependent variable	ln(US imports)	
	(1)	(2)
ln(Population)$_{jt}$	0.954^{a}	0.953^{a}
	(0.016)	(0.017)
ln(GDP/Pop)$_{jt}$	0.908^{a}	0.913^{a}
	(0.012)	(0.012)
ln(Distance)$_{j}$	-0.616^{a}	-0.604^{a}
	(0.048)	(0.047)
(English Language) dummy$_{j}$	0.351^{a}	0.360^{a}
	(0.048)	(0.047)
Terror$_{jt}$	-0.020^{b}	-0.021^{b}
	(0.009)	(0.009)
Neighbor Terror$_{jt}$	-0.627^{a}	
	(0.069)	
(**Far from terror**) dummy$_{jt}$		0.252^{a}
		(0.061)
(**Close to terror**) dummy$_{jt}$		-0.266^{a}
		(0.065)
Fixed Effects:		
Year	yes	yes
Product (5-digit)	yes	yes
Adj. R^2	0.38	0.38
# of Observations	449832	449832

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.

4.2. 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.

Additional exporter controls

We attempt here to control for potential omitted characteristics of the exporting country in specification (14). The objective 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 fixed-effects. However, our variables of terrorism incidents are country j-specific and the overlap with the country j dummies is considerable. Hence, introducing the terror variables and country-j fixed effects would introduce high multicollinearity into the regression. We alleviate this problem by adding a set of income group dummies, following the World Bank's definition: HOECD (High Income OECD); HOTHR (High Income Others); MIDUP (Upper Middle Income); MIDLW (Lower Middle Income) and LOW (Low Income).

Table 3 – Trade and proximity to terrorism: income group j dummies

	(1)	(2)	(3)	(4)
Definition of distance z	Discrete		Continuous	
	Contiguous	Contiguous & Linguistic & Religious		
Terror$_{jt}$	-0.020^b	-0.020^b	-0.020^b	-0.021^b
	(0.010)	(0.009)	(0.010)	(0.010)
Neighbor Terror$_{jt}$	-0.013^a	-0.018^a	-0.704^a	
	(0.003)	(0.004)	(0.066)	
(Far from terror) dummy$_{jt}$				0.371^a
				(0.068)
(Close to terror) dummy$_{jt}$				-0.245^a
				(0.063)
Adj. R^2	0.38	0.38	0.39	0.39
# of Observations	449832	449832	449832	449832

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 distance z.

Table 3 depicts the results of this robustness check using different definitions of distance z based on: the share of only a border in column (1); the share of a border, a language and a religion in column (2); the log of the continuous variable in column (3) and its decomposition in column (4). To save space, we only present the estimates of $\widehat{\beta_1}$ and $\widehat{\beta_2}$. The other estimates are in line with the results of Tables 1 and 2 and can be asked for upon request. The result concerning the income group dummies (not reported here) is worth mentioning, however. All regressions exhibit statistical significant differences across income groups. On average, the low income countries (LOW) trade less with the U.S. than the middle income countries (MIDLW and MIDUP), which trade less with the U.S. than the high income countries (HOECD and HOTHR). Concerning the terrorism estimates, results are not sensitive to these additional controls. They are little changed compared to those of Tables 1 and 2. We still find local negative spillovers on U.S. trade related to the terrorist incidents perpetrated by the neighbor countries. In addition, countries located far enough from the terrorist incidents instead increase their trade with the U.S.

We may also be concerned by the fact that time-*dependent* factors, such as the outward multilateral resistance index, affect our terror estimates. In our theory, all countries trade with the U.S. but are assumed not to trade with each other. This simplification allows to embed the terrorism - U.S. security game in a simple new trade theory model and to obtain a simple testable U.S. bilateral imports specification. Except that in general equilibrium *à la* Anderson and Van Wincoop **?**, where all countries trade together, an additional exporter variable should enter the equation. This is the outward multilateral resistance (OMR), which represents an index of trade costs that exporter faces on its shipments.

The ideal would be to include in our specification time-varying exporter fixed effects or estimated OMRs like in Anderson and Van Wincoop **?** or Anderson and Yotov 2008. Unfortunately, the structure of our data does not allow taking these two routes. The first solution introduces perfect multicollinearity into the regression. Our variables of terrorist incidents represent indeed a linear combination of the exporter-year dummy variables. The second solution is appealing and theoretically consistent in a panel setting [Anderson and Yotov 2008]. However, it proved very difficult (if not impossible) to apply Anderson and Yotov's approach to our data. First, this approach requires to expand the number of importing countries. Hence, to compute the OMR indexes we need information on trade costs that each exporter faces on *all* its shipments, beyond the U.S. market. However, country's directional trade data are not available for all exporters at the 5-digit SITC level over the period 1993-2006. This is all the more problematic for developing countries, which also host terrorist organizations. Second, we need data on individual country expenditures at the product level (5-digit) to calculate the OMR [see equation (5) of Anderson and Yotov 2008]. Unfortunately, we cannot construct these expenditures due to lack of data.[1]

Nevertheless, we may wonder whether the estimates of the elements of the vector $\mathbf{Neighborterror}$ are being biased by the omission of the outward multilateral resistance. And if so, in which direction? In fact, one can easily figure out that the estimates (in absolute value) are being *underestimated*. To see why suppose a case where terrorism activity increases in a given source country. Let's assume that the U.S. responds by increasing security against this country and its close neighbors. It follows that the OMR of these countries would tend to increase, while the relative OMR of safe countries would tend to decrease. So, *ceteris paribus*, a country closer to terror would *increase* its exports to the U.S. This indirect effect is explained as follows: a higher resistance to shipments from this country to its other markets, captured by a higher OMR, tips more trade back into the U.S. Hence, our estimate of the neighbor terror captures both the negative direct effect of the increase of security on trade costs and the indirect positive effect of an OMR increase. As a result, the omission of the exporting country resistance biases downward (in absolute value) the estimate of the terror spillovers. To put it differently, if we could find a way of conditioning out the OMR, the coefficient on the closeness to terror variable should be even more negative.

Alternative definitions of distance to terrorism

Table 4 deals with a second set of robustness checks with respect to alternative definitions of distance z. We consider incidents of the exporting country and the neighbors summed over three and five years, respectively.

Table 4 presents the results of the summation of the number of incidents over different periods of time. As in Table 3, we only report the estimates of $\widehat{\beta}_1$ and $\widehat{\beta}_2$, and use the same discrete and continuous measures of distance z.[2] The incidents are summed over three years in the top part of Table 4 and over five years in the bottom part. Our main results are still valid. 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.

[1]Another issue we would be to deal then computationally with a matrix of exporter and importer multilateral resistance indexes at the product level.

[2]The estimated coefficients of the other variables remained unchanged compared to Tables 1 and 2 can be asked for upon request.

Table 4 – Trade and distance to terrorism: past incidents

Definition of distance z	(1)	(2)	(3)	(4)
	Discrete		Continuous	
	Contiguous	Contiguous & Linguistic & Religious		
	Incidents summed over three years			
Incidents$_{jt}$	-0.015^a	-0.014^a	-0.017^a	-0.021^b
	(0.004)	(0.004)	(0.004)	(0.009)
Neighbor Terror$_{jt}$	-0.008^a	-0.014^a	-0.815^a	
	(0.002)	(0.002)	(0.080)	
(Far from terror) dummy$_{jt}$				0.378^a
				(0.062)
(Close to terror) dummy$_{jt}$				-0.251^a
				(0.066)
Adj. R^2	0.38	0.38	0.38	0.38
# of Observations	449832	449832	449832	449832
	Incidents summed over five years			
Incidents$_{jt}$	-0.010^a	-0.010^a	-0.014^a	-0.024^a
	(0.002)	(0.002)	(0.002)	(0.011)
Neighbor Terror$_{jt}$	-0.007^a	-0.011^a	-1.139^a	
	(0.001)	(0.001)	(0.099)	
(Far from terror) dummy$_{jt}$				0.477^a
				(0.061)
(Close to terror) dummy$_{jt}$				-0.232^a
				(0.066)
Adj. R^2	0.38	0.38	0.39	0.39
# of Observations	449832	449832	449832	449832

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 distance z.

5. CONCLUSION

In this paper we have examined the impact of transnational terrorism diffusion on security and international trade. To counter the diffusion of transnational terrorism, governments implement comprehensive security measures. These measures are directed both against the source countries of terror and their neighbor countries where terrorism may diffuse. By raising trade costs, these measures may affect international 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. In contrast, we demonstrate that countries located far from terror could benefit from an increase in security by trading more. We investigate the empirical validity of these implications with a large data set of trade relationships and terrorist incidents against the United States on the 1993-2006 period. We find (1) a direct negative impact of transnational terrorism on U.S. imports; (2) an indirect negative impact emanating from terrorism of neighbor countries; and (3) that U.S. imports from a given country are increasing with its remoteness to terror. These results are robust to various definitions of the neighboring relationships among countries (i.e. adjacent, linguistic, religious and geographical).

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APPENDIX

6. APPENDIX. DATA SOURCES

Bilateral imports of the United States at the 5-digit SITC level, over the period 1993-2006, come from the NBER World Trade Data [see Feenstra, Schott and Romalis 2002 for details]. Data on distance, contiguity and language come from the CEPII (http://www.cepii.fr/anglaisgraph/bdd/distances.htm). Data on population and GDP per capita come from the World Bank (World Development Indicators). Information on religion come from Alesina *et al.* 2003.

7. APPENDIX. NEIGHBOR RELATIONSHIPS

Table 5 depicts the distribution of the neighbor relationships among countries in the world according to two alternative definitions. The left part of Table 5 gives the distribution of neighbor relationships when countries share a border, a language *and* a religion. Using this definition, we observe that one hundred countries have *no* neighbors, while 69 have at least one. In the extreme case, one country, Saudi Arabia, has seven different neighbors: Iraq, Jordan, Kuwait, Oman, Qatar, United Arab Emirates and Yemen. The right part of Table 5 gives the distribution when countries share only one characteristic, namely a border. We get accordingly a much larger number of neighbor relationships. Thus, we observe that only 29 countries have *no* neighbors. They represent island countries and/or distinct statistical territories. In the extreme case, one country, China, has 15 different (contiguous) neighbors.

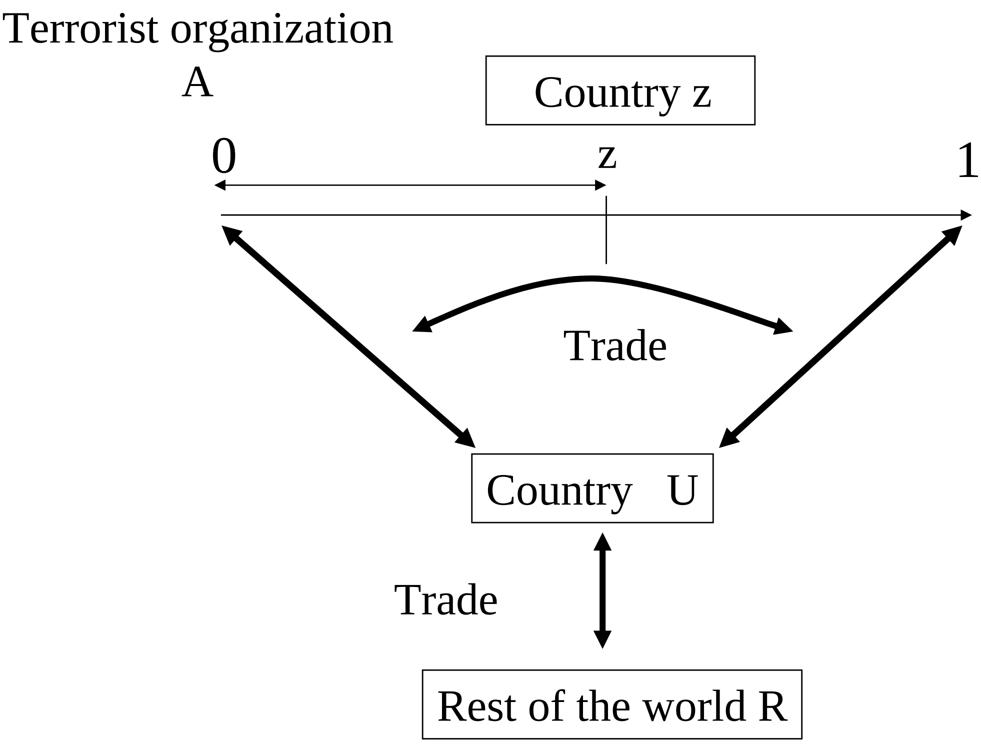
8. APPENDIX. FIGURES

Table 5 – Sample distribution of the neighbor relationships

Countries share:					
a border, a language and a religion			a border		
# of neighbors[a]	Freq. of countries	in %	# of neighbors[a]	Freq. of countries	in %
0	100	59.17	0	29	17.16
1	22	13.02	1	15	8.88
2	22	13.02	2	29	17.16
3	13	7.69	3	23	13.61
4	8	4.73	4	26	15.38
5	2	1.18	5	24	14.20
6	1	0.59	6	7	4.14
7	1	0.59	7	9	5.33
Total	169		8	3	1.78
			9	2	1.18
			14	1	0.59
			15	1	0.59
			Total	169	

Notes: [a] denotes the number of neighbors of a given country, according to the chosen definition.

Figure 1


Terrorist organization
A
Country z
0
z
1
Trade
Country U
Trade
Rest of the world R

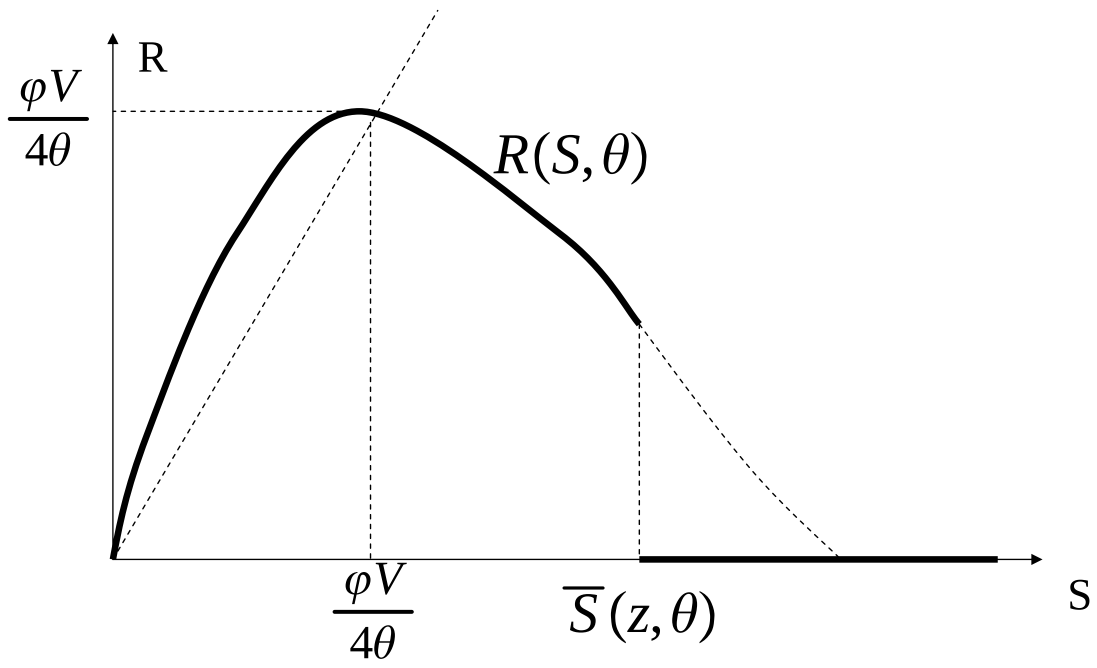


Figure 2: Terrorist Reaction Curve

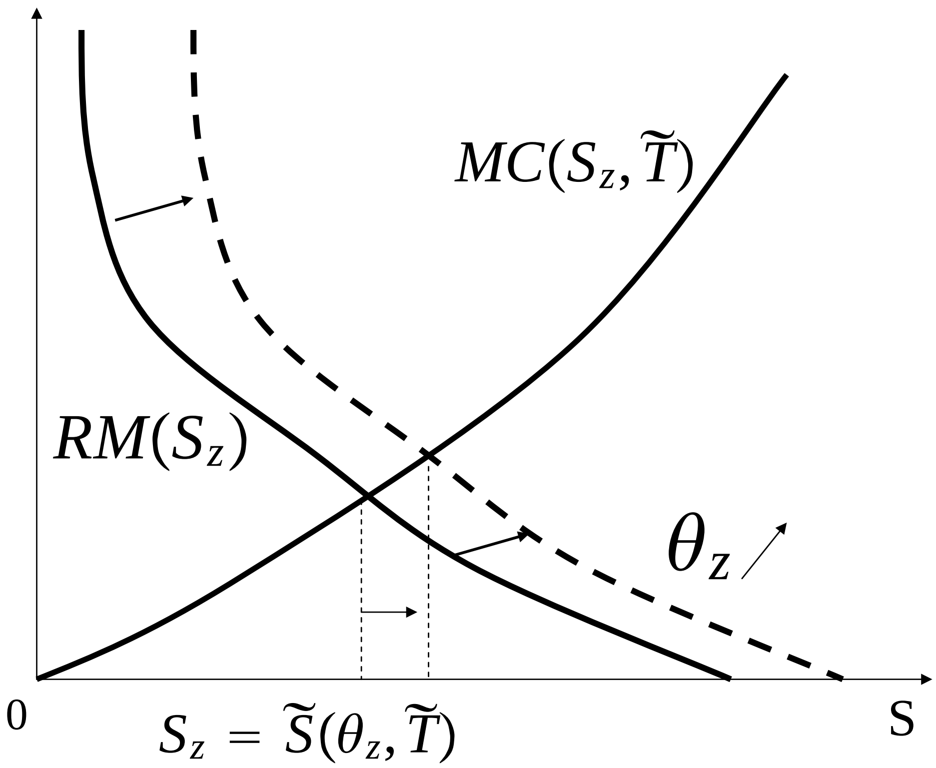


Figure 3a): Optimal Security Measure

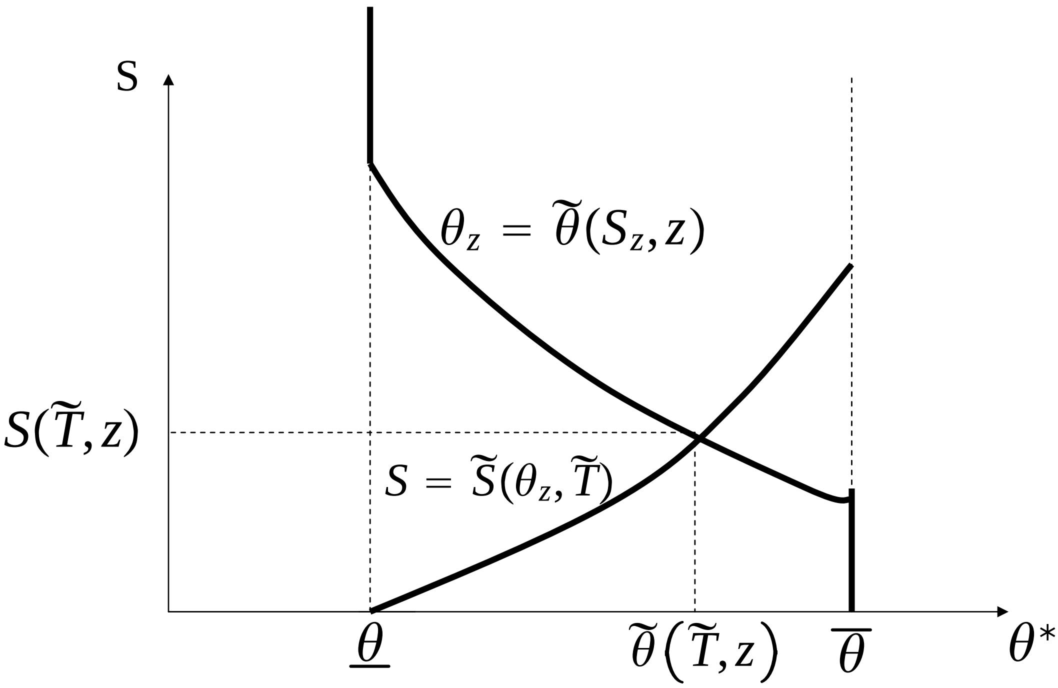


Figure 3b) : Bayesian Equilibrium

Figure 4: Effect of distance

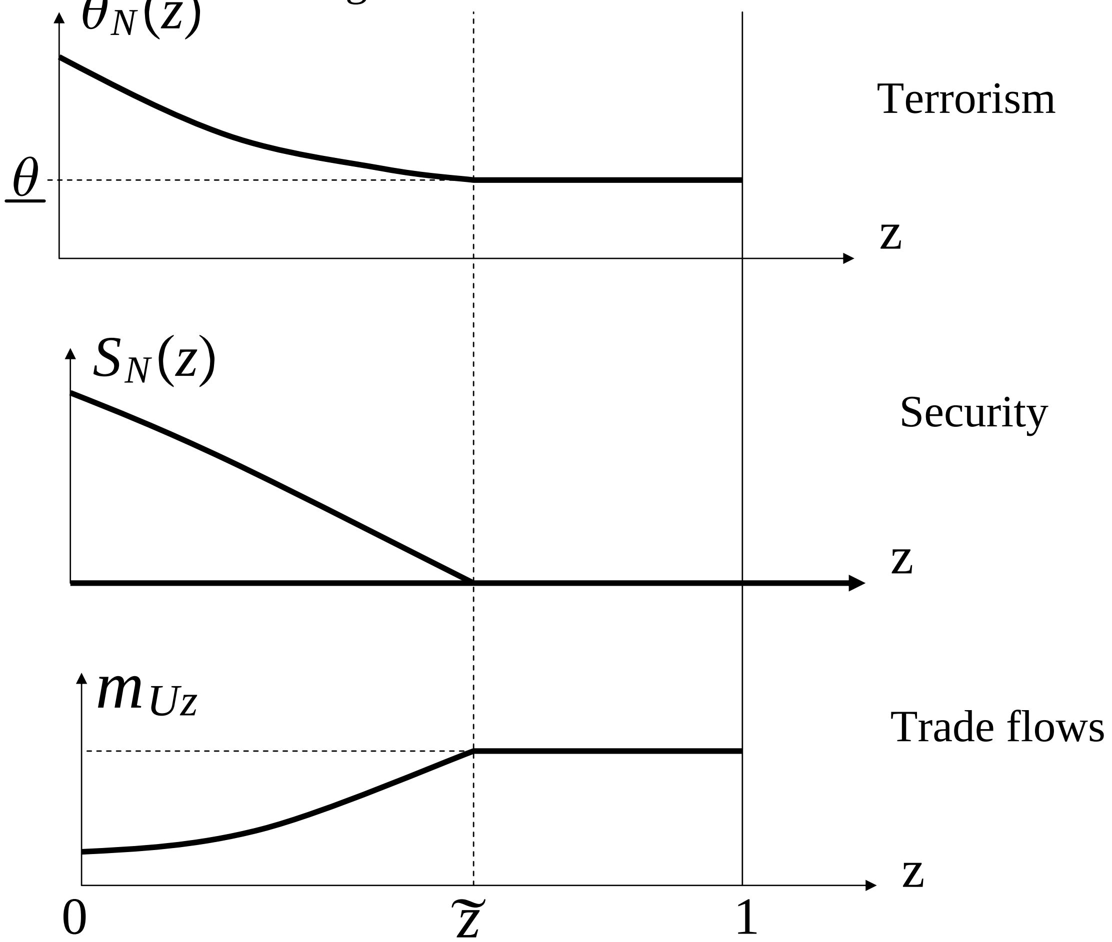


Figure 5: Effect of shock on terrorist cost C