Terror Networks and Trade: Does the Neighbor Hurt?*

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Abstract

This paper studies how network-related terrorism redistributes trade flows across countries, including those countries that are not a direct source of terror. We first develop a game theoretical framework with imperfect information on the spatial location of transnational terrorism to show how the resulting security measures produce a non-monotonic effect on the distribution of trade across countries. Neighbors adjacent to terror, even when they do not source it, have trade reduced through enhanced security measures, while countries farther away benefit from those security measures. Second, to empirically assess the distortional effects of terrorism on trade, we first estimate the structural gravity equation derived from our theory. Then, armed with the estimates of the partial effect of neighbor terror on bilateral trade, we perform a counterfactual experiment and confirm the non-monotonic general equilibrium effect of neighbor terror on trade.

Keywords: Terrorism, trade, security.

JEL classification codes: F12, F13.

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1 Introduction

This paper studies how global terrorist networks distort trade across countries. It theoretically and empirically investigates the relationship among transnational terrorism networks, security reactions and the reallocation of trade flows across countries. Our starting motivation builds upon the three following observations.

First, terrorist networks have been playing an increasingly important role in the expansion of terror in the world since the 1990s. In 2014, more than twenty identified groups worldwide had joined or established close relationships with Al-Qaida. Additionally, in the last couple of years, the world has been observing a dramatic increase in the number of groups that have chosen to pledge allegiance to (or at least coordinate most of their actions with) the Islamic State. Hence, while the collective share of terror networks in total transnational incidents was no more than 5% in the 1990s, it climbed at a yearly average of approximately 20% in the 2000s to reach more than 60% in 2014.[1] Although most of the incidents have been concentrated in certain areas (the Middle East, North and Sub-Saharan Africa, and Central and East Asia), the number of countries and nationalities involved have multiplied by a factor of almost 4 since the 1990s. By 2014, those groups were at the source of approximately 1000 *transnational* incidents in approximately 20 locations against people from more than 35 nationalities amounting collectively to more than 3000 victims, a figure that is equivalent to the 9/11 attacks.

Second, as terrorist networks expand and the level of transnational terrorism threat consequently rises, countries sourcing terrorism *and* countries that are likely to host terrorist cells are more closely monitored. The US Department of State reports recent evidence of active monitoring in Northern Mali, where Al-Qaeda in the Islamic Maghreb (AQIM) and affiliated groups have exploited the political chaos to expand their presence. The US Department of State writes, "[We] are monitoring the actions of AQIM and other extremist and terrorist organizations in the north, and continue to work with the international community to address this evolving threat. [We] continue to enhance our work with Mali's

[1] Transnational incidents are defined as such when they involve incidents perpetrated by some group against some (physical or human) foreign targets or when they are located in a foreign country. Calculations are from the authors based on data from the Global Terrorism Database, a recent and publicly available data set. See https://www.start.umd.edu/gtd/.

neighbors, to increase their capacity to secure their borders, disrupt AQIM supply lines, and contain the spread of extremist groups."[2] Monitoring goes hand in hand with more restrictive security measures, such as increased checks at borders, restrictions on visa allowances or immigration controls. A quick look at the cross-country differences in the number of US non-immigrant visas issued to foreign nationals offers evidence of this restriction. In 2002, after the September 11 attacks, almost every country experienced a reduction in visa allowances, although some countries, especially Muslim ones, have been more affected than others (Cainkar, 2004).[3]

Third, security measures increase the costs of international trade (see Anderson and Marcouiller, 2002; Anderson and van Wincoop, 2004; Mirza and Verdier, 2014). The broadening of such measures may cause a country close to the location of terror to face negative trade spillovers without necessarily being a source of transnational terrorism itself.[4] Figure 1 illustrates this idea by comparing the trade performance of two types of countries. The first type concerns countries that are "safe from terror" in the sense that neither they nor their geographical and cultural neighbors have not been involved in any incident on their soil in the last 5 years of observation.[5] The second type involves countries that are "safe but with neighboring terror" in the sense that no incidents have occurred on their own soil in the last 5 years, while being "potentially prone" to terror, as their neighbors were involved in incidents. We first plot the bilateral observed trade of safe countries (in logs) against trade values predicted by the gravity variables (i.e $\ln(\text{GDP}_i \times \text{GDP}_j/\text{Distance}_{ij})$). Then, we insert the corresponding plot related to countries potentially prone to terror into the same picture. There, one can see how their trade deviates from the trend if they were to belong to a safe neighborhood. The exercise is repeated for 1993 and 2006 for the exact same sample

[2]The rest of the quote is also very insightful "We assist Mauritania and Niger through the Trans-Sahara Counter Terrorism Partnership, which is designed to help build long-term capacity to contain and marginalize terrorist organizations and facilitation networks; disrupt efforts to recruit, train, and provision terrorists and extremists; counter efforts to establish safe havens for terrorist organizations; and disrupt foreign fighter networks that may attempt to operate outside the region." (see http://www.state.gov/p/af/rls/rm/2012/201583.htm).

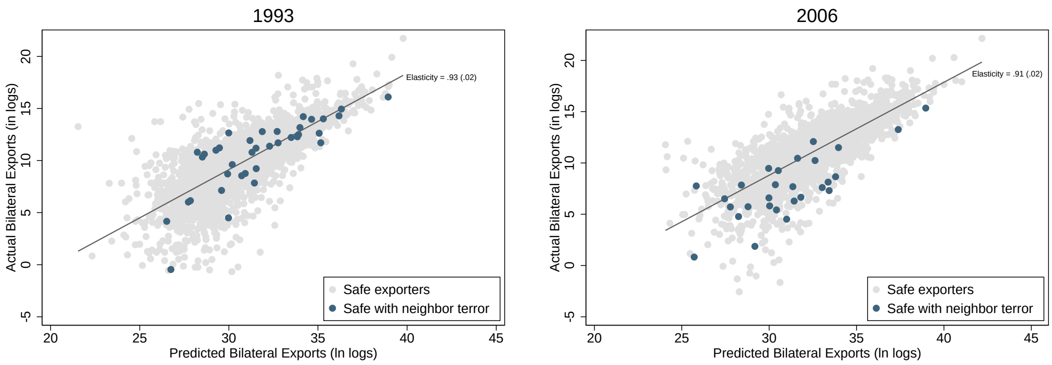
[3]On average, Europeans and Asians experienced a 15% and 23% decrease, respectively. Muslim countries experienced a 40% decrease with a large variance from -1% for Eritrea to -67% for Saudi Arabia.

[4]See Section (3) and Appendix B for a detailed presentation and discussion of the data.

[5]Neighbors are coded as such if they share a border, a language and a religion with the observed country. (see Section (3) for more details).

of countries.[6] Within this period, Al-Qaida's international network was developing extensively with a corresponding security reaction from the OECD country authorities, especially after the September 11 (New York) and March 11 (Madrid) events in 2001 and 2004, respectively. The figure shows that in 1993, the potentially unsafe countries did not deviate from the trend of the safe ones. In 2006, however, most of the neighboring terror countries were observed to be under the average performance of the safe countries.[7]

Figure 1: Bilateral Exports of Close-to-Terror Countries and Deviation from Potential



Notes: Each dot stands for one pair of countries involving a 'safe exporter country', that is, a country with no terrorist incidents reported in the previous 5 years. However, some of these exporters, depicted by a dark blue dot, have neighbor(s) who commit terrorism against the importer in the pair. The neighbor relationships are defined based on shared characteristics: a border, an official language, and a religion. The figures in 1993 and in 2006 contain the same sample: 2116 country pairs composed of 53 exporter and importer countries. Each figure plots the actual bilateral exports (in logs) against the predicted bilateral exports (in logs). The predicted flows between exporter i and importer j are exports predicted by a simple gravity equation $(\ln(GDP_i) \times \ln(GDP_j) / \ln(DIST_{ij}))$. . The elasticity coefficients from the OLS regression of the log actual exports on the log predicted exports are reported with standard errors.

The aim of this paper is to show that global terrorist networks and security reactions produce trade externalities. These distort trade across countries even when the countries are *not* hosting terrorist cells. In particular, they make 'victim' countries to trade *less* with close-to-terror countries (i.e., those likely to host terror in the future even when they are presently observed to be safe). Incidentally, however, terrorist networks make 'victim' countries to trade *more* with far-from-terror countries (i.e., those unlikely to host terror).

For our analysis, we first develop a theoretical framework to analyze the im-

[6]The years 1993 and 2006 mark the beginning and the end of our empirical study, respectively (see below for details about this period).

[7]We have plotted the same figure for each of the years covered by our period, and a relatively monotonic growing downward deviation of trade related to neighboring countries since 2001 was observed. Graphs can be provided upon request.

pacts of the spatial location of transnational terrorism on security measures and international trade. Our model consists of two building blocks. The first one is a game theoretical setup in which a global terrorist organization strategically interacts with the government of a potential target country. The global terrorist network acts as a 'multinational' organization extending its activity outside its main hosting country's borders through the implementation of 'affiliates' (i.e., terror cells). The national government of the target country has imperfect knowledge about the location of the terror cells and implements a set of global security measures at the regional level. The second part of our model is a standard monopolistic imperfect competition model of international trade that connects to our game theoretical setup through the fact that security measures have trade cost implications. In this framework, we characterize the Bayesian Nash equilibrium of the strategic game between the terrorist network organization and the national government of the target country, and we investigate the consequences for international trade flows across countries. The theory highlights two testable implications. First, countries sufficiently neighboring the country of residence of the main terrorist organization bear higher relative transaction costs and thus export less to security-setting countries. Second, any shock that increases the social cost of terror induces a further reduction of exports of close-to-terror countries while incidentally producing an increase in trade with far-from-terror ones. A major conclusion from our theoretical analysis is that transnational terrorism may shape international trade flows in subtle ways. Indeed, terror and counter-terror policies do not only directly affect bilateral flows between source countries and target countries through the traditional transaction cost channel; rather, they can also contaminate trade flows involving "potentially unsafe" countries because of the informational regional externalities associated with global terrorist networks. Interestingly, such features may in turn lead to further trade diversion and substitution effects across parts of the world not yet touched directly by terrorist incidents.

Our second contribution is empirical. We take the preceding implications to the test. For this, we merge detailed information on transnational terrorist acts from the ITERATE database (see Mickolus *et al*, 2006)[8] with bilateral export data

[8]The International Terrorism: Attributes of Terrorist Events (ITERATE) project defines terrorism acts as "the use, or threat of use, of anxiety-inducing, extra-normal violence for political pur-

across countries at the 3-digit ISIC industrial level. We choose the 1993-2006 period for our analysis to avoid a series of three crises that occurred after that period, i.e., the food and oil price crises (2007-2008), the financial and economic crises (2009-2010) and the Arab Spring revolutions (2010-2012). These crises could easily have simultaneously affected the trade and terrorism variables at the regional level, thereby making the identification of neighbor effects of terror on trade difficult.

Using trade and terror information, we then proceed in three steps. First, we build a measure of proximity to terrorism based on the sharing of 'affinities' between countries, such as a border, a language or a religion. We argue that the more affinities a country shares with a source country of terrorism, the closer their neighborhood relationship and the higher their likelihood to host a terror cell.

Second, using the proximity-to-terror measure, our theoretically derived gravity model of trade, and conditioning on a large set of fixed effects, we estimate a partial and negative spillover effect of being close to terror. We find that the presence of incidents perpetrated by an exporter's neighbor against a given importer produces a tax-equivalent on bilateral trade flows of the exporter that lies mainly between 1 and 6%. This negative externality still holds when we consider a subsample of only safe exporting countries. Typically, safe countries surrounded by an unsafe neighborhood still under-perform compared with those surrounded by safe neighbors. We further find that this negative externality from the neighborhood is mainly driven by incidents observed in the world after 2001, where presumably many victim countries began enlarging the scope of their security policies to monitor a whole region instead of specific countries.

Finally, based on our preferred estimate of neighbor terror and the iterative structural estimation of inward and outward multilateral resistances suggested by our theory and the work of Anderson and Van Wincoop (2003) and Anderson and Yotov (2010), we perform counterfactual experiments to gauge how cost increases due to terrorism affect international trade. Namely, we confirm contrasting spillover effects based on the distance to the source country of terrorism:

poses 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."

the exports of *potentially unsafe*, i.e., close-to-terror, countries are negatively hit by terrorism incidents originating from their neighbors, while countries in a safe environment, i.e., far-from-terror, experience positive spillovers on their trade. Thus, the analysis of the counterfactual experiment of doubling the amount of neighbor terror against the US confirms an interesting non-monotonic spillover effect: the 40 countries with neighbor terror against the US reduce their exports to the US by a range of 1.8% to 2.1% on average, while each of the 71 countries with no neighbor terror against the US increase their exports by 0.20% to 0.35% on average.

Our paper contributes to the theoretical and empirical literature related to terrorism, security and trade. On the theory side, our paper builds upon the important game theoretical literature that highlights rational incentives and strategic interactions between terror organizations and governments (Sandler, Tschirhart and Cauley, 1983; Lapan and Sandler, 1988; Bueno de Mesquita, 2005; Sandler and Siqueira 2006, Siqueira and Sandler 2010).[9] In the specific context of trade, we connect to Anderson (2015), providing a simple model featuring interactions among trade, terrorism and public policy through a common labor market supplying trade workers, enforcement patrols, economic predators and terrorists; however, while there is some extensive discussion on trade policy issues in this context, the paper differs from ours by focusing on a one-country context. Moreover, it does not consider issues associated with bilateral or multilateral trade flows and regional transaction cost externalities.

On the empirical side, our paper relates to the literature on trade and violence indicating that terrorism and/or conflicts tend to have significant impacts on trade flows (Blomberg and Hess, 2006, Glick and Taylor, 2010, Martin *et al.* 2008). Typically, Blomberg and Hess (2006) found that for a given country and year, the presence of terrorism together with external and internal conflicts is equivalent to as much as a 30% tariff on trade. Other studies focus more specifically on transnational terrorism and bilateral trade.[10] Using a sample of 200 countries over the period of 1960-93, Nitsch and Schumacher (2004) find that a doubling of terrorist incidents in a pair of trading countries in one year tends to reduce

[9]See Schneider, Brück, and Meierrieks (2015) for an exhaustive review of the economic literature on terrorism and counter-terrorism and Sandler (2014) for a recent review of the analytical literature.

[10]See Mirza and Verdier 2008 for a survey of this literature.

bilateral trade flows by approximately 4% in that year. More recently, Egger and Gassebner (2015) find few bilateral trade effects in the short term, but they find significant medium-term effects of terrorism on trade. Bandyopadhay and Sandler (2014) emphasize the role of general equilibrium supply-side reallocation effects of terrorism on trade and suggest that they might go in the opposite direction to the effects of transaction costs. In a recent paper, Bandyopadhyay, Sandler and Younas (2016) use product-level data to show that transnational terrorism affects more bilateral trade than domestic terrorism, which is consistent with the idea that transnational terror is associated with higher transaction costs at the borders.[11]

Closer to this paper, Mirza and Verdier (2014) highlight the relationship among trade, terrorism and security measures. However, the paper does not consider the possibility of terrorist networks spreading across countries or the spillovers from terrorism to countries not yet affected by terrorism. Also related to our study, Fratianni and Kang (2006) consider the importance of common land borders and show that the impact of terrorism on bilateral trade declines as the distance between trading partners increases. This therefore suggests that terrorism redirects trade from closer to more distant countries. Our paper also indicates the possibility of trade diversion effects due to terrorism, but we emphasize the role of informational regional externalities that a global terror country can have on the trade flows of its *potentially* unsafe neighbors with other target economies.

The rest of the paper is structured as follows. In section 2, we construct a simple theoretical framework composed of the endogenous spatial locations of terrorism and security embedded into a new standard trade model. In section 3, we first explain the empirical strategy and present data on terrorism. Then, we present the benchmark econometric results and robustness checks. Finally, we perform counterfactual experiments to gauge how cost increases from terrorism affect international trade. In section 4, we conclude our findings.

[11]There is also an important literature studying the macroeconomic losses from terrorism and in particular those related to production (see the survey by Enders and Sandler, 2011 or Abadie and Gardeazabal (2003) seminal paper). Of course production losses may in turn affect trade, although without distorting trade across partners *a priori*. As it will be made clearer below we set-up a theory and run corresponding empirical specifications that aim at identifying the spillover effects of terrorism originating from neighborhood countries that distort trade across partners.

2 A Simple model of trade, spatial location of terrorism and security

In this section, we present the basic elements of a simple model composed of trade, spatial location of transnational terrorism and security. There are two types of countries that are engaged in international trade. First, there is a country u (e.g., the US) that is the main target of transnational terrorism. Second, there is a continuum of countries of mass 1 (indexed by z) located on the segment $[0,1]$. Some of them are potential sources of terrorism against u.

2.1 Trade

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

$$u_u = \left[\nu_u x_{uu}^{(1-1/\sigma)} + \int_0^1 \nu_z x_{uz}^{(1-1/\sigma)} dz \right]^{1/(1-1/\sigma)},$$

where ν_ℓ is the number of varieties produced in each country $j \in \{u,\, z \in [0,1]\}$. $x_{u\ell}$ is country u demand for a variety of country j. 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:

$$P_u = \left(\nu_u p_u^{1-\sigma} T_{uu}^{1-\sigma} + \int_0^1 \nu_z p_z^{1-\sigma} T_{uz}^{1-\sigma} dz \right)^{1/(1-\sigma)},$$

where p_j is the mill price of products made in j and T_{uj} are the usual iceberg trade costs between u and K. If one unit of good is exported from country j to country u only $1/T_{uj}$ 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 j is given by

$$m_{uj} = \nu_j E_u \left[\frac{p_j T_{uj}}{P_u} \right]^{1-\sigma} \text{ for } j \in \{u, z \in [0,1], R\}, \quad (1)$$

where E_u is the total expenditure of country u.

Labor is the only factor of production in quantity L_j in country $j \in \{u, z \in [0,1]\}$. In each country, the different varieties are produced under monopolistic competition. The entry cost to produce in a monopolistic sector is supposed to be one unit of a freely tradable good which is chosen as world numeraire. This good is produced in perfect competition. In turn, this 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 indicate that mill prices in the monopolistic competitive sector are identical and are equal to the mark-up $\sigma/(\sigma-1)$ times marginal costs (also equal to 1). On the supply side, free entry implies that $\nu_j = L_j/\sigma$. In equilibrium, the indirect utility of the representative consumer in country u is:

$$W_u = W_u(\mathbf{T}_u) = \frac{E_u}{\frac{\sigma}{\sigma-1}(\sigma)^{\frac{1}{\sigma-1}}}\left(L_u T_{uu}^{1-\sigma} + L\int_0^1 T_{uz}^{1-\sigma} dz\right)^{1/(\sigma-1)},$$

where $L_z = L$ for all countries $z \in [0,1]$ and $\mathbf{T}_u$ is the vector of internal (T_{uu}) and external ($T_{uz\{z\in[0,1]\}}$) bilateral iceberg trade costs. As is well known from this simple model, one obtains bilateral imports of country u from country j:

$$m_{uj} = L_j E_u T_{uj}^{1-\sigma} P_u^{\sigma-1}. \tag{2}$$

2.2 Terrorism and security

Location and spatial activity of terrorism

We assume that the headquarters of a terrorist organization A is located at $z = 0$ (see Figure 2). A is acting like a multinational terrorist network. Thus, in each country $z \in [0,1]$, A may establish a terrorist cell to gear an attack from z against country u.

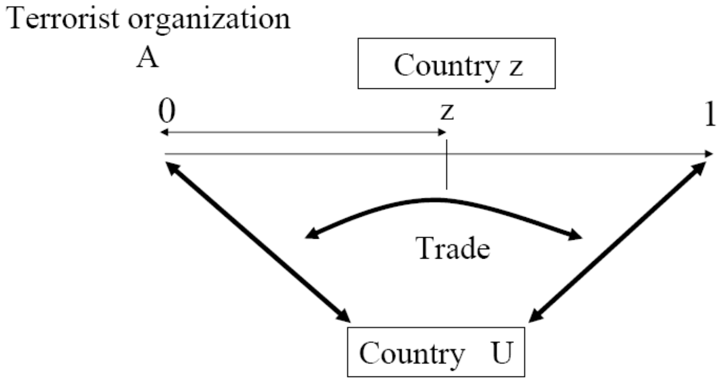
We consider that each cell, once established, benefits from the same technology of terrorism as the headquarters. In a sense, this is the intangible specific asset of the multinational terrorist network. However, to capture the decentralized organizational feature of the network, we consider that each cell is maximizing its objective function independently from the other cells in the network. The objective function of a particular cell is to obtain visibility (which helps it capture political or economic rents).[12] More precisely, a terrorist cell in country $z \in [0,1]$ maximizes the following:

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

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

Figure 2: Terrorist Organization

Figure 1



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 the 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 that is (as mentioned) a specific characteristic of the terrorist network.

We now introduce a spatial dimension. We assume that, to establish 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 the 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 established in country z if and only if the expected net rent from terrorism is larger than the fixed establishment 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, we follow Anderson and Marcouiller (2002) and take a simple asymmetric contest success function:

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

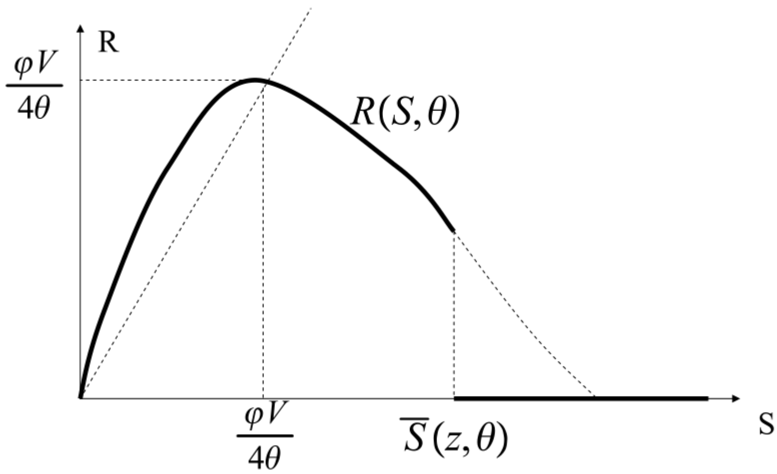
with the technological parameter $\varphi > 0$ reflecting the relative efficiency of terrorism compared to security.

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

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

Equation (terror) considers the fact that a terrorist cell is established in country z if and only if $Max_{R_z}\left[\Pi(R_z,S_z)V - \theta R_z\right] \geq F(z)$. The shape of the reaction curve is depicted in Figure (3). When the security level S_z imposed by u against z is below a certain threshold $\overline{S}(z,\theta)$, the transnational terrorist organization chooses to establish 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 location in country z and $R_z = 0$.

Figure 3: Terrorist Reaction Curve



Security behavior by u

The government of country u is concerned by both the economic welfare of the representative consumer $W_u(\mathbf{T}_u)$, which depends on the vector of bilateral iceberg trade costs $\mathbf{T}_u$, and the expected social cost of terrorism imposed on its citizens $E(C)$. To fix these ideas, consider that the government maximizes the following:

$$G_u = \ln W_u(\mathbf{T}_u) - E(C),$$

where C is the social cost of terrorism in country u when it succeeds. We assume that, because of pervasive problems of asymmetric information, the government of country u, when deciding its 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. The government has beliefs on this parameter, which is summarized by the density function $f(\theta)$ defined on an interval $\left[\underline{\theta}, \overline{\theta}\right]$. Additionally, the decision regarding 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, $R_z^e(\theta)$,

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

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

Security measures $\mathbf{S} = \{S_z\}_{z\in[0,1]}$ against terrorists involve trade costs.[13] Imposing security measures against people and goods from country z is likely to increase trade costs (e.g., security checks, time delays, restrictions on visa allowances to business people, and immigration controls). Recalling that T_{uz} represents the bilateral trade costs between u and z, we simply pose the following:

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

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

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

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

Given that the equilibrium wage is 1 and the labor force available for production in country u is L_u, country u's expenditure on consumption goods is written as $E_u = L_u$. Neglecting constant terms and noting $R^e(.) = (R_z^e(.))_{z\in(0,1)}$, the problem (US) can be rewritten as:

$$\begin{aligned} Max_S\ W(S, R^e(.)) &= Max_S\ \frac{1}{\sigma-1}\ln\left(L_u T_{uu}^{1-\sigma} + L\int_0^1 T_{uz}^{1-\sigma}dz\right) \\ &\quad -C\int_{\underline{\theta}}^{\overline{\theta}}\left[\int_0^1 \frac{\varphi R_z^e(\theta)}{\varphi R_z^e(\theta)+S_z}dz\right] f(\theta)d\theta. \end{aligned}$$

Using Fubini's theorem, the government of country u maximizes:

$$\begin{aligned} Max_S\ W(S, R^e(.)) &= Max_S\ \frac{1}{\sigma-1}\ln\left(L_u T_{uu}^{1-\sigma} + L\int_0^1 T_{uz}^{1-\sigma}dz\right) \\ &\quad -C\int_0^1\left[\int_{\underline{\theta}}^{\overline{\theta}} \frac{\varphi R_z^e(\theta)}{\varphi R_z^e(\theta)+S_z} f(\theta)d\theta\right] dz. \end{aligned}$$

Equilibrium

We now look for the Bayesian Nash equilibrium of the terrorism-security game. 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 a terrorist activity function $R_z^N(.)$ defined on $\left[\underline{\theta}, \overline{\theta}\right]$ and is characterized by the two following conditions:

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

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

We can equivalently redefine the Bayesian Nash equilibrium as a couple (S^N, θ^N), with $S^N = (S_z^N)$ and $\theta^N = (\theta_z^N)$ such that

$$(i)\ S^N = Arg\max_S\ \left[\begin{array}{c} \frac{1}{\sigma-1}\ln\left(L_u T_{uu}^{1-\sigma} + L\int_0^1 T_{uz}^{1-\sigma}dz\right) \\ -\ C\ \int_0^1\left[\int_{\underline{\theta}}^{\theta_z^N} \frac{\varphi R_z^N(\theta)}{\varphi R_z^N(\theta)+S_z} f(\theta)d\theta\right] dz \end{array}\right], \tag{5}$$

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

and the equilibrium thresholds θ_z^N for all $z \in [0,1]$ are defined by

$$\overline{S}(z, \theta_z^N) = S_z^N. \tag{7}$$

Given that $\overline{S}(z,\theta) = \left[\sqrt{V} - \sqrt{F(z)}\right]^2 \frac{\varphi}{\theta}$, inverting (7) provides a threshold function $\widetilde{\theta}(.)$ such that[14]

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

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

$$\frac{LT_{uz}^{-\sigma}}{\widetilde{T}^{1-\sigma}}\frac{dT_{uz}}{dS_z} = C\int_{\underline{\theta}}^{\theta_z} \frac{\varphi R_z^N(\theta)}{\left[\varphi R_z^N(\theta) + S_z\right]^2} f(\theta)d\theta, \tag{8}$$

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

$$\widetilde{T}^{1-\sigma} = \left(L_u T_{uu}^{1-\sigma} + L\int_0^1 T_{uz}^{1-\sigma}dz\right).$$

The left hand side of equation (8) is the marginal cost $MC(S_z, \widetilde{T}) = \frac{LT_{uz}^{-\sigma}}{\widetilde{T}^{1-\sigma}}\frac{dT_{uz}}{dS_z}$, 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 also note its dependence on the aggregate trade friction cost index $\widetilde{T}$ of country u. The larger this index, the larger the volume that country u imports from country z and the costlier it is at the margin to impose trade frictions between u and z. Hence, the marginal cost $MC(S_z, \widetilde{T})$ of security measures S_z between u and z is larger.

The right-hand side of equation (8), $RM(S_z) = C\int_{\underline{\theta}}^{\theta_z} \frac{\varphi R_z^N(\theta)}{\left[\varphi R_z^N(\theta)+S_z\right]^2} f(\theta)d\theta$, is the marginal benefit of security measures on the probability of no occurrence of a terrorist act emanating from z. It depends on the belief that the government of u

[14]The threshold function $\widetilde{\theta}(.)$ is defined by

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

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

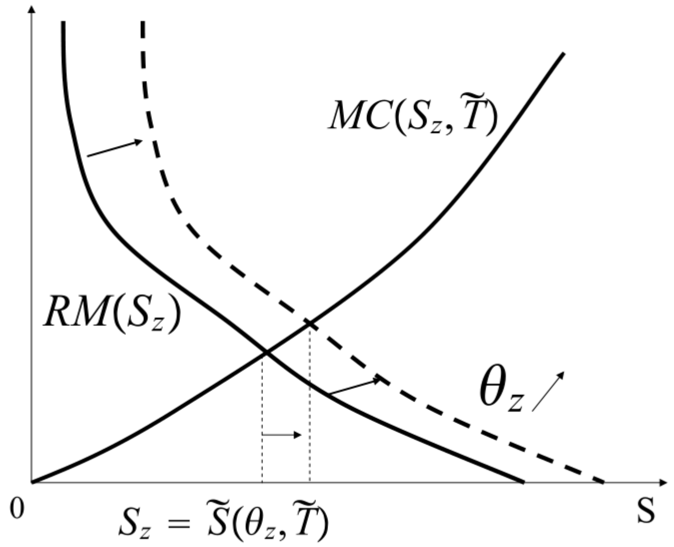
has on the amount of resources $R_z^N(\theta)$ spent by a terrorist cell in z. It is easy to see that $RM(S_z)$ is decreasing in S_z.

Substituting equation (6) into the first-order condition (8), we obtain the following:

$$MC(S_z, \widetilde{T}) = C\int_{\underline{\theta}}^{\theta_z}\left(\frac{\sqrt{\theta}}{\sqrt{\varphi V}}\frac{1}{\sqrt{S_z}} - \frac{\theta}{\varphi V}\right)f(\theta)d\theta. \tag{9}$$

This is illustrated in Figure (4). The right-hand side of equation (9) is again the marginal benefit of security $RM(S_z)$. It is shifted up with the threshold θ_z. In other words, the larger the set of parameters θ such that transnational terrorism is located in country z, the larger the marginal gain to impose security against that country. Simple inspection shows that (9) has a unique solution $S_z = \widetilde{S}(\theta_z, \widetilde{T})$ which is increasing in the threshold θ_z, decreasing in $\widetilde{T}$ and such that $\widetilde{S}(\underline{\theta}, \widetilde{T}) = 0$.

Figure 4: Optimal Security Measure



We easily obtain the following proposition:

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

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

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

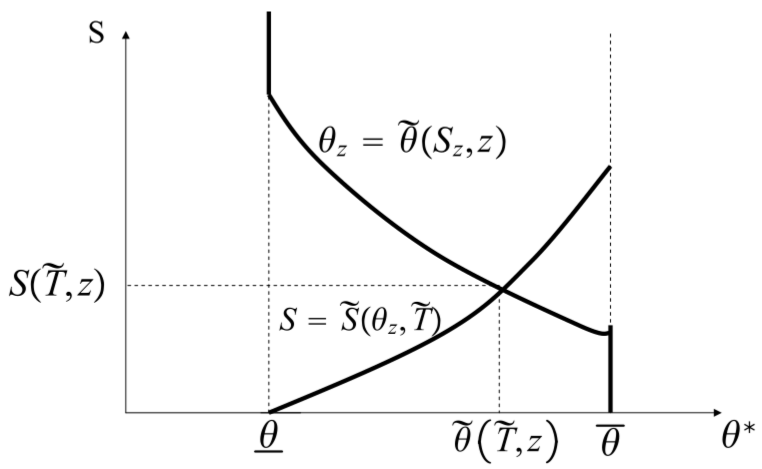
$$R_z^N(\theta) = R(S_z^N, \theta) = \frac{1}{\varphi}\left[\sqrt{\frac{\varphi V}{\theta}} S_z^N - S_z^N\right] \text{ for } \theta < \theta_z^N,$$
$$= 0 \qquad \text{for } \theta \geq \theta_z^N.$$

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

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

Characterization of the Bayesian equilibrium is illustrated in Figure (5) for $z \leq \widetilde{z}$.

Figure 5: Bayesian Equilibrium



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 is located, the larger the benefits of security measures imposed by country u against country z. However, the threshold curve $\theta_z = \widetilde{\theta}(S_z, z)$ is decreasing in S_z. A larger level of security against country z reduces the profitability of establishing a terrorist cell in that country. This establishment requires a higher level of efficiency (i.e., a lower value of θ). The intersection of these two curves gives the solutions $S_z = S(\widetilde{T}, z)$ and $\theta_z = \widetilde{\theta}\left(\widetilde{T}, z\right)$. In appendix A, we show that there is a unique $\widetilde{T}$ consistent with these solutions, and therefore, there is a unique Bayesian Nash equilibrium.

We can now derive our two main comparative statics:

a) How does the distance to the terrorist organization headquarters influence the transnational terrorism location, bilateral security and trade flows across countries?

b) How does 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) affect trade flows across countries?

Let us consider the first comparative static. A simple inspection of Figure (5) shows immediately how the equilibrium outcome varies with the distance z to the terrorist organization headquarters.

Proposition 2 *Whenever a terrorist cell can be implemented, (i.e., for $z \leq \widetilde{z}$), we find that: i) θ_z^N is a decreasing function of z, ii) S_z^N is a decreasing function of z.*

Hence, the incentives for the location of transnational terrorism and the level of security applied to country z both decrease with the distance z to the terrorist organization headquarters. In other words, as the distance z increases, the organizational cost to establish a terrorist cell and the perceived probability of the location of terrorist activity decreases. This consequently reduces the level of bilateral security imposed by country u. These two effects are summarized in the first two panels of Figure (6).

The effect of the terrorism location on the trade flows between country u and country z is easily deduced from the equation characterizing their bilateral trade:

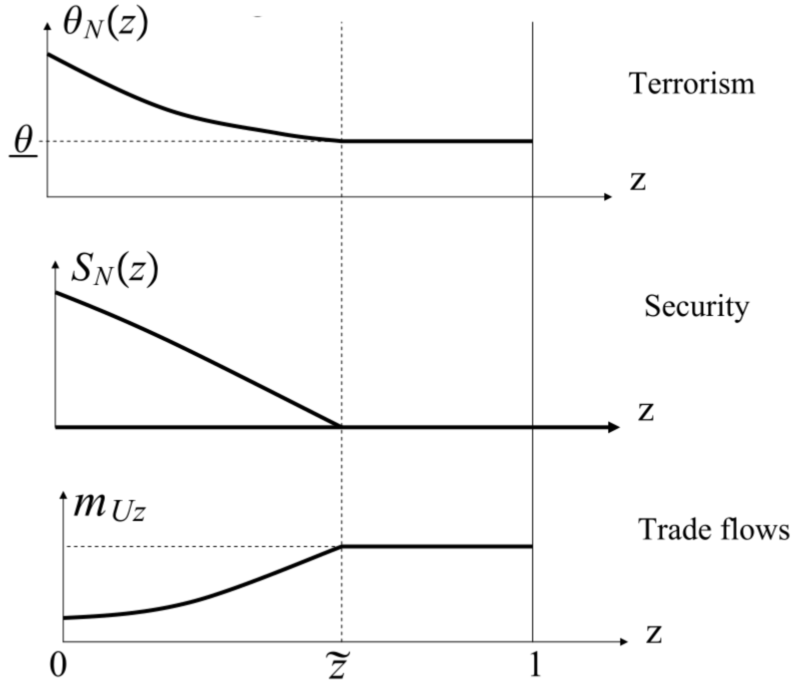
$$m_{uz} = \frac{LL_u T (S_z^N)^{1-\sigma}}{(\widetilde{T}^*)^{1-\sigma}}. \tag{10}$$

The following is easily verified:

Proposition 3 *m_{uz} is strictly increasing in z for $z \leq \widetilde{z}$ and $m_{uz} = const.$ for $z > \widetilde{z}$ (i.e., is unaffected by terrorism).*

Proposition (3) suggests that transnational terrorism has some local negative spillover effects on bilateral trade (m_{uz}). The closer the location of country z is to

Figure 6: Effect of Distance

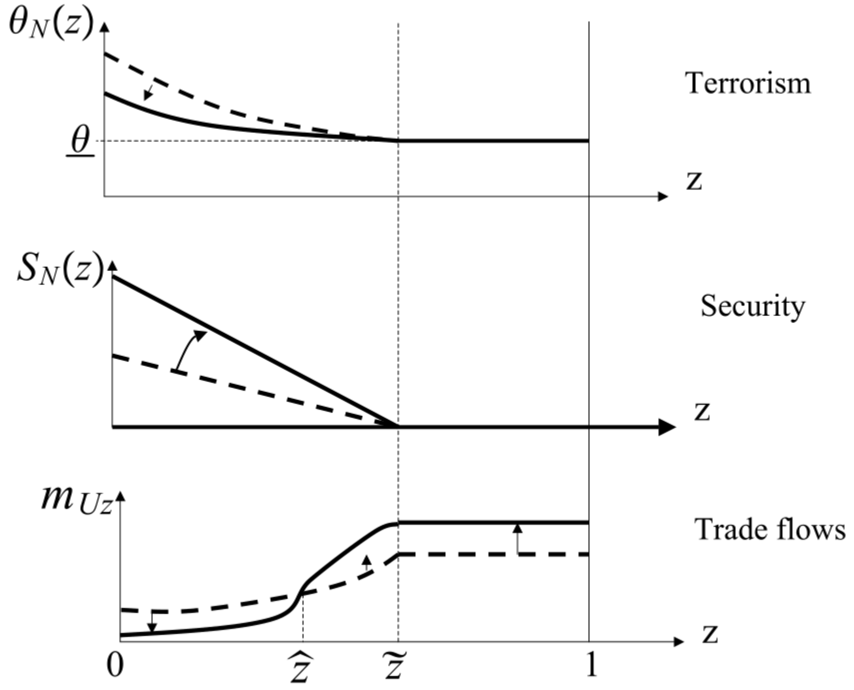


the terrorist organization headquarters in 0, the lower the trade between countries u and z. This effect is depicted in the bottom panel of Figure (5).

Consider now the second comparative static, i.e., the effect of an exogenous shock on security measures. As seen in equation (9), 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 $z \leq \widetilde{z}$ and remain constant ($S_z^N = 0$) for $z > \widetilde{z}$. The security function S_z^N rotates around the 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 $z \leq \widetilde{z}$ and remain constant $\theta_z^N = \underline{\theta}$ for $z > \widetilde{z}$. These two effects are depicted in the first two panels of Figure (7).

Two effects on trade volumes can be distinguished. They are summarized in the bottom panel of Figure (7). First, it can be shown that with an increase in security, the trade friction cost index $\widetilde{T}^*$ shifts upward. Consequently, all countries benefit from an increase in the (inward) multilateral trade resistance of u. Therefore, the trade flow of z to u is increased by high trade costs from other suppliers to u, as captured by inward multilateral resistance. Second, countries with $z \leq \widetilde{z}$ also suffer from increased bilateral security measures that penalize

Figure 7: Effect of Shock on Terrorist Cost C



their trade with u. The overall effect will depend on the location of z to the terrorist organization headquarters at $z = 0$. Trade with country u will increase for countries with $z > \widetilde{z}$, as they only face the positive multilateral resistance 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 resistance effect due to the increased security.[15] In other words, for countries z close enough to the terrorist headquarters (i.e., $z \leq \widehat{z} \leq \widetilde{z}$), 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 $z > \widehat{z}$.*

3 Empirical analysis

We now take the theory to the data. In Subsection 3.1, we first present how we can estimate the theory with the data at hand. Particular attention is drawn to

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

the identification strategy and the construction of the empirical counterpart of the theoretical variable z, i.e., the proximity of the location of the terror cell to the terrorist organization. The theory shows that the closer the cell is to the terrorist organization, the larger the negative spillovers of this terrorist neighbor on the cell country's trade with country u. Then, in Subsection 3.2, we estimate the partial effect of neighbor terror on bilateral trade based on the derived theoretical gravity equations (1) and (10). Finally, in Subsection 3.3, armed with the partial effect of neighbor terror and the gravity estimates, we perform a counterfactual experiment to evaluate the total costs of neighbor terror on trade, including its incidental effect (i.e., the effect coming through the price terms). This experiment is designed to depict the non-monotonic effect of increased security derived in Proposition (4).

3.1 From theory to estimation

Our theoretical model predicts that global terrorist networks distort trade across countries, making 'victim' countries to trade less with close-to-terror countries and more with far-from-terror countries. However, in moving from theory to estimation, we face one major issue. The underlying mechanism inducing trade distortions relies on increased security, but cross-country data on security measures are unfortunately unavailable. In lieu of direct measures of increased security, we use observable terrorist incidents that are assumed (backed by the theory) to induce increased security targeted at the source country of terrorism and their neighbors. This reasonable assumption is supported by solid evidence linking business visa allowances with terror incidents (see Appendix F).

3.1.1 The empirical strategy

Figure 8 illustrates our empirical strategy based on observable incidents. Consider a country u importing from country z. This bilateral trade relationship is represented by the black plain arrow. Suppose now that the importer country u is the victim of terrorism from country n, as represented by the thick dashed (red) arrow. In response to terrorism, u implements security measures (the dotted blue arrow) that are designed to prevent terror not only from n, which hosts a terrorist organization, but also from z. The reason for this is that n and z are neighbors, and the terrorist organization in n may diffuse terrorism through the exporter country

z to reach u (the thin dashed red arrows). Accordingly, by increasing trade costs, these measures may reduce exports from z to u. Thus, neighbor terror induces a negative spillover effect on trade. Additionally, we expect that the more closely related n and z are, the higher the probability of the terror location and the larger the security measures and the spillovers on the exports of z.

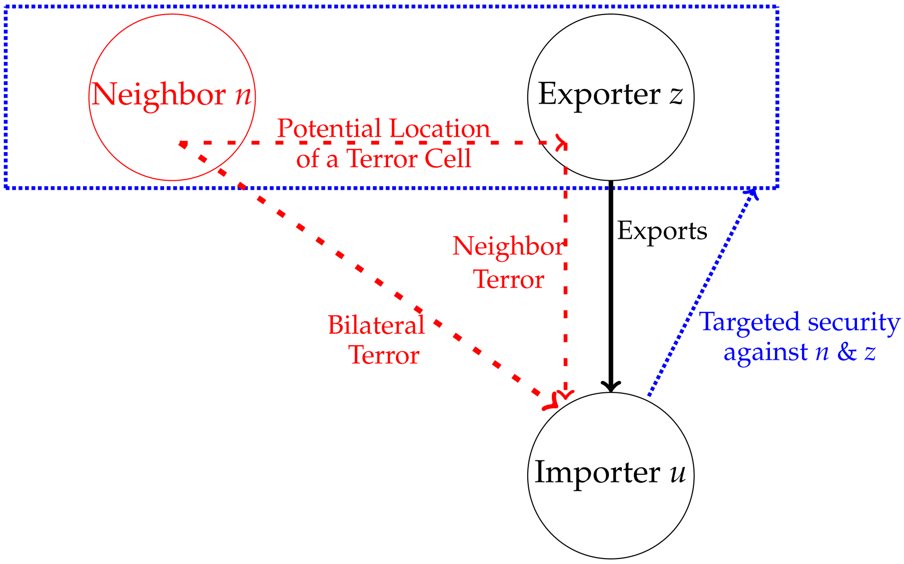


Figure 8: Effect of Neighbor Terror on Trade

Our empirical strategy requires an identification (i.e., from the data) of the three types of countries represented in Figure 8: (1) importer countries u that are victims of terror, (2) exporter countries z, and (3) their 'neighbors of terror' n, which perpetrate terrorism against u and may diffuse terror through z. We will be flexible in the way we determine how closely n is related to z.

3.1.2 Exogeneity of neighbouring terror assumption and disaggregated trade

Regarding trade, we use *disaggregated* bilateral exports from z to u at the 3-digit sector level k. This disaggregation of flows helps us to avoid a potential reverse causality that would have existed had we chosen to work with *aggregate* trade flows. The literature mentions the possible impact of a country's openness on terrorism activity through labor reallocation between sectors. In particular, openness might induce changes in the opportunity costs of people engaged in informal sectors in general and particularly in some related terror activities, making them more (or less) willing to quit the latter for more formal ones (see Anderson, 2008 and Mirza and Verdier, 2014).

Our identifying assumption is that the terror behavior of the neighboring country n against the importer u is exogenous to the *disaggregated* trade relationship between z and u (see Figure 8). It is quite unlikely that changes in bilateral exports from z to u in one particular 3-digit manufacturing sector explains why the neighbor n is perpetrating incidents against u.

Disaggregated bilateral exports data come from de Sousa et al. (2012). For each of the 26 reported 3-digit industries, 113 countries are exporting and importing from 1993 to 2006.[16] Some of these countries might be victims or sources of terrorism. Some others might be safe, but they might be geographically or culturally close to other countries with active terror cells.

3.1.3 Transnational terrorist incidents: source and victim countries

Data on transnational terrorist incidents come from the ITERATE database established by Mickolus et al. (2006). This is an event-based data set that lists all of the transnational terrorist incidents in the world that have been reported in the media during our period of analysis. International or transnational terrorism is defined 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 government authority, when such action is intended to influence the attitudes and behavior of a target group wider than the immediate victims and when, through its location the mechanics of tis resolution, its transcend national boundaries," Mickolus et al. (2006). ITERATE excludes terrorist incidents associated with declared wars or major military interventions and guerrilla attacks on military targets of an occupying force. ITERATE provides information on the date, the country of location of the attack, and the nationalities of terrorists and victims. This helps us to define the source and victim countries of terror.

Source countries of terror. We define a source country of transnational terror based on a simple criterion: the nationality of its perpetrator(s). This criterion precisely defines the source country of terror because a staggering 98% of the attacks reporting information on the nationality document only one nationality per attack (see Blomberg and Rosendorff, 2009). However, despite its appealing simplicity, this criterion is not free of shortcomings. First, information on nationality

[16] The list of countries and industries are tabulated in Tables (9) and (10) in Appendix E. Data sources are described in Appendix B.

is not always available, and one-third of the incidents were discarded because of the unknown nationality of the perpetrator(s). Then, multiple nationalities can be reported for a given incident. In that case, the source country is defined as the most represented nationality among the perpetrators, if one exists. Next, we may be concerned by the fact that the nationality of the perpetrator(s) may not represent the view of the country with which it is associated. We abstract from this problem as long as victim countries implement security measures against the source countries of terror, regardless of the representativeness of the terrorists' views. Finally, the source country might not be the country of location of the incidents, which is defined as the place where they have taken place. However, in the data, we observe that in most cases the source country is also the country of location of the incident, e.g., this is the case in 96% of the incidents perpetrated against the US.

Based on the ITERATE data, we identify 115 source countries of terror, i.e., countries that have perpetrated at least one transnational terrorist incident between 1993 and 2006.[17] This attests that transnational terrorism is a widespread phenomenon. Table (8) in Appendix B reports the number of incidents per source country (mean, 13 incidents; standard deviation, 27.69). The top ten source countries of transnational terrorism between 1993 and 2006 are Colombia, Turkey, Palestine, Iraq, Somalia, Algeria, Pakistan, Yemen, Egypt and Iran. Over the study period, organizations from these ten countries have perpetrated more than 80 transnational incidents each on average.

Victim countries of terror. We also define a victim country of terrorism based on the nationality of its citizen victim(s). ITERATE defines victims as "those who are directly affected by the terrorist incident by the loss of property, lives, or liberty." In nearly 80% of the incidents, the victim(s) is (are) of one nationality. We can thus associate confidently only one victim country to an incident. For the incidents with victims of multiple nationalities, we define, as described above, the victim country as the most represented nationality among the victims, if one exists; otherwise, the incidents are dropped. We assume implicitly that the most

[17] Notice that not all of the 115 identified source countries in ITERATE are included in our estimation sample (indicated with a star in Table 8) due to missing trade and production data at disaggregated levels. However, we exploit information on all of the source countries of terror to construct our neighbor-to-terror variables.

represented nationality is the targeted one. Note that the citizens of the victim country can be hit at home or abroad.

Between 1993 and 2006, 79% of the countries in our estimation sample have been the victim of a least one transnational terrorist incident (perpetrated by the above source countries). Note that the US has been by far the country most targeted by transnational terrorism during our period of investigation, with 819 incidents reported against the US versus 176 for Great Britain, 169 for Turkey and 120 for France (see Table 9 in Appendix B).

3.1.4 Neighbor terror: construction of the proximity measure to terror

To empirically assess the spillover impact of neighbor terror on trade patterns, we construct a measure of the proximity to terrorism that enables us to link the exporter country z to its neighbors. We proceed in three steps. We first define neighbor relationships among countries based on shared characteristics, i.e., a border, an official language, and a religion.[18] We use different combinations of shared characteristics, e.g., two countries would be considered as neighbors when they share a border only or when, in addition, they also share a language and a religion. We simply argue that the more characteristics the countries share, the closer their neighborhood relationship.

In a second step, we count, for each combination of shared characteristics, the number of an exporter's neighbor(s) $n = 0, 1, ..., N$.[19] As an illustration, defining neighborhood relationships based only on the sharing of a border, Sudan has seven contiguous neighbors n in our sample, namely Central African Republic, Chad, Democratic Republic of the Congo, Egypt, Ethiopia, Kenya, Libya and Uganda. Alternatively, by using a definition based on the sharing of a border, a language and a religion, Sudan has three neighbor countries n in our sample, namely, Chad, Egypt and Libya.

The neighbor countries n can (or not) be a source of terror, i.e., hosting a terrorist organization that can diffuse a cell in z to reach u. To determine how safe a neighbor is, we construct a proximity-to-terrorism variable in a third step. For each combination of shared characteristics between n and z, $Proxim_{uzt}(n)$ sums

[18] We consider that two countries share a religion when a common religion is practiced by at least 50% of the population in each country.

[19] We use the seven different combinations of shared characteristics: {border, language, religion}, {border, language}, {border, religion}, {language, religion}, {border}, {language} and {religion}.

the number of terrorist incidents perpetrated by the neighbor(s) n of z against a victim country u in a year t. Formally, for a given combination of shared characteristics between n and z:

$$\text{Proxim}_{uz,t}(n) = \sum_{n=1}^{N} \left(\text{TerrorIncidents}_{nu,t} \times \text{Neighbor}_{nz}\right), \tag{11}$$

where $\text{TerrorIncidents}_{nu,t}$ is a variable that sums the number of incidents perpetrated by each neighbor n against u in year t; and Neighbor_{nz} is equal to one if countries n and z are neighbors, zero otherwise. As an illustration, in 1993, the three neighbors with whom Sudan shares a border, a language and a religion in our sample (i.e., Chad, Egypt and Libya) perpetrated 4 terrorist incidents against $u = \{\text{United States}\}$. Therefore, the $Proxim_{uz,t}(n)$ value in this case equals 4. We assume that the higher this value is, the closer z is to neighbor terror against u.

Table (1) tabulates the distribution of $Proxim_{uz}(n)$ over the period of 1993-2006 when the neighbor relationships are defined based on the sharing of a border, a language and a religion. The observations tabulated here represent approximately 1% of the total bilateral trade observations uz between 1993 and 2006. Among the bilateral relationships experiencing neighbor terror, two-thirds record 1 incident, and approximately 85% experience at most 3. We have also collected some statistics regarding the number of victims related to these incidents (defined here as persons killed or injured by the incidents). The statistics show that 5% of the bilateral relationships associated with neighbor terror resulted in 0 victim, up to 25% resulted in 1 victim and 50% resulted in 3 victims. At the tail end of the distribution, 10% of the observations are associated with more than 135 victims.

Next, we make use of the $Proxim_{uz,t}(n)$ variable to capture the impact of neighbor terror on trade.

3.2 The partial effect of neighbor terror on trade

Our theory explicitly states the fact that neighbor terrorism, through a higher security reaction at the borders, has a partial and a full effect on bilateral trade (see equation 10). This partial effect holds multilateral resistances or price indexes constant, while the full effect also accounts for price index changes.

We first estimate the partial effect of neighbor terror on trade using a more general gravity equation with multiple exporter and importer countries. This

Table 1: Neighbor incidents against victim countries between 1993 and 2006

Number of neighbor incidents$_{uz}(n)$	Number of observations$_{uz}$ with neighbor incidents	Cumulative percentage
1	6,283	0.651
2	1,299	0.786
3	706	0.859
4	375	0.898
5	171	0.916
6	226	0.939
7	149	0.954
8	52	0.959
9	106	0.970
10	135	0.984
11	18	0.986
12	24	0.989
14	25	0.992
15	23	0.994
16	19	0.996
88	34	1
Total	9,645	

Notes: The observations tabulated here represent approximately 1% of the total bilateral trade observations uz between 1993 and 2006. Neighborhood relationships between n and z are defined here as sharing a border, a language and a religion. Col 1: Number of incidents perpetrated by z's neighbor(s) n against a victim country u. Col 2: Number of bilateral observations between importer (victim) country u and exporter country z with neighbor incidents. Col 3: Cumulative percentage of bilateral observations with neighbor incidents.

specification nests our derived theoretical gravity equations (1) and (10). The difference is that our theory simplifies the dimensionality of the analysis by focusing on one importer country only. This simplification allows us to build a tractable general equilibrium model for studying the full effect of neighbor terror on trade. Empirically, we enrich the analysis by considering multiple importer countries. Using a multi-country specification allows us to compute inward and outward multilateral resistances and then perform a counterfactual experiment that simulates the full general equilibrium effect of neighbor terror on trade.

3.2.1 Specification

Our multi-country specification for a given sector is linked to Equation (1) and is based on

$$m_{uz,t} = \frac{Y_{zt}E_{ut}}{Y_t}\left(\frac{T_{uz,t}}{P_{ut}\Pi_{zt}}\right)^{1-\sigma}, \tag{12}$$

where $m_{uz,t}$ represents the import value to country u from country z in year t. We introduce a time subscript, as we are using panel data. Beyond a slight change in notation, the main difference between equations (12) and (1) (and 10) lies in the introduction of the outward multilateral trade resistance or exporter price index Π_{zt}, which is a consequence of adding multiple importers (see Anderson and van Wincoop, 2004).

Expression $\left(\frac{Y_{zt}E_{ut}}{Y_t}\right)$ is the frictionless trade ratio. It relates bilateral trade to the economic size of both partners, i.e., the sales of goods at destination prices from country z to all destinations (Y_{zt}) and the expenditure of country u on products from all origins (E_{ut}). The product $Y_{zt}E_{ut}$ is normalized by the nominal value of the world output (Y_t). Expression $\left(\frac{T_{uz,t}}{P_{ut}\Pi_{zt}}\right)$ is referred to as the *trade cost friction ratio*. Thus, bilateral trade is related to bilateral trade costs T_{uzt} as well as to outward Π_{zt} and inward P_{ut} multilateral resistances:

$$\Pi_{zt}^{1-\sigma} = \sum_{u} \left(\frac{T_{uz,t}}{P_{ut}}\right)^{1-\sigma} \frac{E_{ut}}{Y_t}, \tag{13}$$

$$P_{ut}^{1-\sigma} = \sum_{z} \left(\frac{T_{uz,t}}{\Pi_{zt}}\right)^{1-\sigma} \frac{Y_{zt}}{Y_t}. \tag{14}$$

3.2.2 The fit to the data

We now fit Equation (12) to the data as follows. First, we transform the equation in logs[20] and let $\alpha_{zt} + \alpha_{ut} = \ln Y_{zt} + (\sigma - 1)\ln \Pi_{zt} + \ln E_{ut} + (\sigma - 1)\ln P_{ut}$. It follows that, for a given sector:

$$\ln m_{uzt} = (1-\sigma)\ln T_{uz,t} + \alpha_{zt} + \alpha_{ut}, \tag{15}$$

where α_{zt} is an exporter-by-year fixed effect and α_{ut} is an importer-by-year fixed effect. They absorb all of a country's time-varying confounding factors that can affect trade, such as the economic size, which is typically measured with the GDP, multilateral resistance effects, as well as the economic development and quality of institutions, which are typically measured with the GDP per capita and country indexes.

Second, we posit that trade costs are a stochastic log-linear function of observ-

[20] We also check the robustness of our results by estimating our specification in levels and using the Poisson pseudo-maximum likelihood (PPML) estimator (Santos Silva and Tenreyro, 2006). The results are qualitatively similar with two notable differences. First, the partial effect estimates of neighbor terror are always comparatively larger with PPML than the estimates reported in the text. Then, due to convergence issue, the PPML does not allow for the introduction of country-pair fixed effects on top of exporter-by-year and importer-by-year fixed effects. Results are available upon request.

ables:

$$T_{uz,t} = \prod_{b=1}^{B} (\ell^b_{uz,t})^{\gamma_b} \; \tau_{uz,t}(n) \; \exp(\varepsilon_{uz,t}), \tag{16}$$

where $\varepsilon_{uz,t}$ is a random error, which captures all of the unobserved linkages between u and z that affect bilateral trade costs over time. Normalizing such that $\ell^b_{uz,t} = 1$ measures zero trade barriers associated with a given variable b, $(\ell^b_{uz,t})^{\gamma_b}$ is equal to one plus the tax equivalent of b (Anderson and van Wincoop, 2004). As in many empirical applications, the list of bilateral observable arguments $j^b_{uz,t}$ includes the geodesic distance, official language, adjacency, border effects, regional trade agreements and currency unions. Part of these bilateral arguments are time-invariant. They are wiped out when country-pair fixed effects (α_{uz}) are introduced in some specifications. In our setting, $\ell^b_{uz,t}$ also includes arguments accounting for direct terrorism of z against u independent of any neighbor terror activity.[21]

$\tau_{uz,t}(n)$ is the argument with which this paper is mostly concerned. It is the one related to the spillover effects of neighbor terror. In other words, trade costs between u and z increase with the security measures, such as security checks or time delays, designed to prevent terror from neighbor countries. We specify $\tau_{uz,t}(n)$ in two alternative ways, both of which are closely related to the $Proxim_{uz,t}(n)$ variable (Eq. 11). The first specification is *Discrete*:

$$\tau^D_{uz,t}(n) = \tau^{\mathbb{1}\{\text{Proxim}_{uz,t}(n)>0\}}, \tag{17}$$

where $\mathbb{1}$ denotes the indicator function. Therefore, whenever a neighbor of country z perpetrates at least one terrorist incident against u, $\tau^D_{uz,t}(n) = \tau$ would measure the increase in trade costs due to neighbor terror. By replacing equation (17) in the trade cost specification (16), the gravity equation (15) used to for the estimation at the 3-digit industry level becomes:

$$\ln m_{uz,t} = \alpha_{zt} + \alpha_{ut} + \sum_{b=1}^{B} \lambda_b \ln z^b_{uzt} + \beta^D \mathbb{1}\{\text{Proxim}_{uz,t}(n) > 0\} + \varepsilon_{uz,t}, \tag{18}$$

where $\lambda_b = (1-\sigma)\gamma_b$. The estimate of interest is $\beta^D = (1-\sigma)\ln\tau$, and the ad-valorem tax equivalent of neighbor terror is given by $\tau - 1 = \exp\left(\frac{\beta^D}{1-\sigma}\right) - 1$.

[21]Notice that the general terrorism activity of z, which is not u specific, is absorbed by the introduction of exporter-by-year fixed effects, α_{zt}.

Alternatively, we use a more flexible and *continuous* specification:

$$\tau^{C}_{uz,t}(n) = (1 + \text{Proxim}_{uz,t}(n))^{\eta}\,, \tag{19}$$

where η measures the sensitivity of bilateral trade-costs to incidents sourced in the neighborhood of z. Notice that a value of 0 incidents brings $\tau_{uz}(n)$ down to 1, which implies no induced barrier to trade. Using the continuous specification of equation (19), the gravity equation used for the estimation at the 3-digit industry level now becomes:

$$\ln m_{uz,t} = \alpha_{zt} + \alpha_{ut} + \sum_{m=1}^{M} \lambda_m \ln z^{m}_{uz,t} + \beta^{C} \ln(1 + \text{Proxim}_{uz,t}(n)) + \varepsilon_{uzt}, \tag{20}$$

where $\lambda_m = (1-\sigma)\gamma_m$. The estimate of interest is $\beta^C = (1-\sigma)\eta$, given that the ad-valorem tax equivalent of terror is now $\tau - 1 = (1 + \text{Proxim}_{uz,t})^{\left(\frac{\beta^C}{1-\sigma}\right)} - 1$.

3.2.3 Empirical results on the partial effect of neighbor terror on trade

We estimate equations (18) and (20) using sector-level data k. We use various fixed-effect estimators capable of handling different combinations of characteristics specific to the sectors, the years and the exporter and importer countries. In the most saturated specifications below, we use sector (α_k), exporter-by-year (α_{zt}), and importer-by-year (α_{ut}) fixed effects in addition to country-pair fixed effects (α_{uz}). These fixed effects will absorb most of the typical gravity-like variables used in the literature, such as the GDP, multilateral resistances, bilateral distance, and contiguity.

In Table 2, we first report the estimates of equation (18) using the *discrete* measure $\tau^{D}_{uz}(n)$. Standard errors are clustered at the country-pair level to address potential problems of heteroskedasticity and autocorrelation in the error terms.

Before discussing the neighbor terror estimates, we begin by showing the results of a series of basic estimations (columns 1 to 4) where exporter and importer effects are assumed not to vary over time. We relax this assumption in the rest of the paper. Besides, notice that we do not use country-pair fixed effects in this table. Consequently, the traditional bilateral trade costs proxies, such as the geodesic distance and the indicators of regional trade agreements, common language, common land border and border effect (the so-called home bias), appear with the expected and statistically significant signs. The currency union dummy

Table 2: Baseline estimations of trade and neighbor terror (1993-2006)

Dependent variable: ln(Industry Exports) from Exporter$_z$ to Destination$_u$ at time t					
	(1)	(2)	(3)	(4)	(5)
		Discrete form: $\tau^D_{uz}(n)$			
Shared characteristics of exporter z and neighbor(s) n:[1]		B	BL	BLR	BLR
Exporter's neighbor terror against destination$_{uz(n),t}$		**-0.019**	**-0.192**^{a}	**-0.197**^{a}	**-0.216**^{a}
		(0.037)	(0.062)	(0.067)	(0.069)
Exporter's terror against destination$_{uz,t}$	0.092	0.093	0.099	0.097	0.118
	(0.070)	(0.070)	(0.070)	(0.069)	(0.072)
Exporter's terror against *all* destinations$_{z,t}$	-0.041^a	-0.041^a	-0.041^a	-0.041^a	
	(0.010)	(0.010)	(0.010)	(0.010)	
Regional trade agreement$_{uz,t}$	0.389^a	0.388^a	0.386^a	0.385^a	0.440^a
	(0.043)	(0.043)	(0.043)	(0.043)	(0.048)
Currency union$_{uz,t}$	0.009	0.009	0.007	0.007	-0.051
	(0.066)	(0.066)	(0.066)	(0.066)	(0.074)
Ln distance$_{uz}$	-1.323^a	-1.323^a	-1.324^a	-1.325^a	-1.315^a
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Common language$_{uz}$	0.686^a	0.686^a	0.692^a	0.691^a	0.683^a
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
Common land Border$_{uz}$	0.771^a	0.771^a	0.768^a	0.768^a	0.759^a
	(0.086)	(0.086)	(0.086)	(0.086)	(0.086)
Border effect$_{uz}$	4.135^a	4.132^a	4.123^a	4.122^a	4.163^a
	(0.180)	(0.180)	(0.180)	(0.180)	(0.181)
Observations	834,540	834,540	834,540	834,540	834,540
R^2	0.664	0.664	0.664	0.664	0.671
Fixed Effects:					
industry (3 digit)	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	-
Exporter	yes	yes	yes	yes	-
Importer	yes	yes	yes	yes	-
Exporter × Year	-	-	-	-	yes
Importer × Year	-	-	-	-	yes

Notes: [1]Shared characteristics between exporter z and neighbor(s) n are defined as: B sharing a land border, BL sharing a border and a language, and BLR sharing a border, a language, and a religion. Heteroskedastic-robust standard errors in parentheses, clustered by exporter-destination pair. ^{a} indicates significance at the 1% confidence level.

has no effect on trade, however.[22]

In addition to all traditional trade cost proxies, we have added two controls related to terrorism sourced in the exporter country z itself. The first control is a dummy taking on 1 if incidents are sourced in z against destination u and 0 otherwise. The second control is a dummy variable taking on 1 whenever an incident is perpetrated by terror groups from z against any other country in the world, and 0 otherwise. While the estimate of the exporter's terror against *all* destinations is statistically significant with an expected negative sign, the estimation of the exporter's *bilateral* terror against u appears not to be statistically significant in the shown specifications. One important reason for the non significance of this control variable has to do with the endogeneity of bilateral incidents to bilateral trade, as exposed in detail in Mirza and Verdier (2008), Mirza and Verdier (2014) or Anderson (2015). For instance, we expect a negative effect of *bilateral* terror on bilateral trade through higher transaction costs, but country pairs facing terrorism appear to be trading much more between themselves than with other countries, mainly for geographic and historical reasons (see Mirza and Verdier, 2008). [23]

We now turn to the results linked to our variable of interest, i.e., spillover effects coming from neighbor terror (using here the discrete form $\tau^D_{uzt}(n)$). Recall that the proximity-to-terror variable ($\text{Proxim}_{uzt}(n)$) is constructed for different combinations of shared characteristics between z and the neighbor(s) n. From column 2 onwards, we introduce them progressively to check the sensitivity of our results to different measures of proximity. Notice, in passing, that the introduction of the neighbor terror variable does not change the sign and magnitude of the estimates obtained in column 1. In column 2, the neighbor terror dummy is constructed based only on one shared characteristic, i.e., a common land border

[22]The elasticity of trade to distance is somewhat higher than the mean elasticity of 0.9 found in the literature (see Disdier and Head, 2008). The regional trade agreement variable, which is an indicator that equals one if both countries belong to a regional trade agreement in year t, the common land border variable, which is set to one if both countries are contiguous, and the common language variable, which is set to one if a language is spoken by at least 9% of the population in both countries, have expected positive estimates. The border effect dummy is equal to one for intranational trade (i.e., $u = z$), and zero otherwise. The border effect estimate in column 1 implies that each country traded on average approximately 55 times more [= exp(4)] within its national borders than with another country of the world. This high border effect or home bias is not so much surprising when developing countries are considered (see de Sousa *et al.*, 2012).

[23]More precisely, we have noticed that the sign and significance of the obtained estimator on *bilateral* terror is not robust to the sample of countries considered, the set of explanatory variables included, or the different sets of fixed effects introduced.

between z and its neighbor(s). Then, in column 3, we add the official language to the border.[24] Finally, in columns 4 and 5, three factors are added up to define proximity to terror: a common border, a common language and a common religion.

The results depict a stark difference regarding neighbor terror estimates. In column 2, the estimate is negative but not significant and smaller in magnitude than the last three columns of the table. This difference is in line with the reasonable assumption that the more characteristics a country z shares with its neighbors, the more closely related they are. Therefore, we expect neighbor terror to be more detrimental to trade between u and z in columns 3 through 5, because security measures against z will be higher to prevent any location of terror. This difference is also reassuring if we consider that security measures are not designed randomly but instead use 'profiling'. Two countries can be geographically close by sharing a land border without being closely related otherwise. Thus, our results suggest, that holding the other factors constant, sharing a border is not a sufficient condition to increase the probability of location of terror (col. 2). Countries sharing a land border could be at war, for instance. It is only when they *also* share a language and a religion that the spillover effects become highly and statistically significant (col. 3 through 5).

In column 5 of Table (2), the time-varying monadic terms (such as the GDP, quality of institutions, and level of economic development) are eliminated by introducing exporter-by-year and importer-by-year fixed effects little effect on the neighbor terror estimate. Even after taking these effects into account, an exporter that experiences neighbor terror exports 19% $[= (\exp(-0.216) - 1) \cdot 100]$ less on average to u than an exporter with no neighbor terror.

In table (3) we compare the results obtained for the discrete measure with those that we obtain when we run regressions using the continuous measure, i.e., $\ln(1 + \text{Proxim}_{uz}(n))$, as an alternative. Both measures produce a similar impact with regard to the magnitude and significance using the same set of fixed effects (col. 6 vs. 8 and col. 7 vs. 9). The reason for this comes from their high pairwise correlation. Obviously, when no incident is reported both measures take 0. When 1, 2 or 3 incidents are reported, which represent 85% of the cases (see Table 1), the discrete measure is set to 1, while the continuous measures equal 0.69, 1.10 and

[24]Note that adding the religion instead gives similar results, which are available upon request.

1.38, respectively.

Table 3: Trade and neighbor terror: continuous and discrete measures

Dependent variable: ln(Industry Exports) from Exporter$_z$ to Destination$_u$ at time t				
	(6)	(7)	(8)	(9)
Shared characteristics of exporter z and neighbor(s) n:[1]	Discrete $\tau^D_{uz}(n)$		Continuous $\tau^C_{uzt}(n)$	
Exporter's neighbor terror against destination$_{uz(n),t}$	**-0.214^a**	**-0.059^b**	**-0.174^a**	**-0.058^a**
	(0.069)	(0.024)	(0.063)	(0.023)
Regional trade agreement$_{uz,t}$	0.440^a	0.240^a	0.440^a	0.240^a
	(0.048)	(0.021)	(0.048)	(0.021)
Currency union$_{uz,t}$	-0.048	-0.008	-0.041	-0.007
	(0.074)	(.021)	(0.074)	(0.029)
Ln distance$_{uz}$	-1.315^a		-1.315^a	
	(0.030)		(0.030)	
Common language$_{uz}$	0.684^a		0.686^a	
	(0.046)		(0.046)	
Common land border$_{uz}$	0.762^a		0.761^a	
	(0.086)		(0.086)	
Border effect$_{uz}$	4.172^a		4.172^a	
	(0.183)		(0.183)	
Observations	834,540	834,540	834,540	834,540
R^2	0.671	0.723	0.671	0.723
Fixed Effects:				
Industry (3 digit)	yes	yes	yes	yes
Exporter × Year	yes	yes	yes	yes
Importer × Year	yes	yes	yes	yes
Exporter × Importer	-	yes	-	yes

Notes: [1]Relationships between z and n are defined as sharing a border, a language, and a religion. The neighbor terror measure is defined as (1) discrete when measured with a binary variable, which is unity if exporter's neighbor(s) n committed terror incidents against destination u or (2) continuous when measured with the number of terror incidents of the exporter's neighbor(s) n against the destination u. Heteroskedastic-robust standard errors in parentheses, clustered by exporter-destination pair. ^{a} and ^{b} indicate significance at the 1% and 5% confidence levels, respectively.

Table 3 compares further the results without pair effects (columns 6 and 8) with those where they are now introduced (respectively, 7 and 9). Notice then that the statistical significance of the neighbor terror estimate persists even when adding a demanding control such as the country-pair fixed effects (col. 7 and 9). The magnitude of the estimate is divided by almost 4, however. Based on the estimate of column 7, an exporter that experiences neighbor terror exports 5.7% [$= (\exp(-0.059) - 1) \cdot 100$] less on average to u than an exporter with no neighbor terror. This reduction in magnitude is the logical consequence of introducing country-pair fixed effects into the regression, which captures any time-independent and unobservable bilateral factor affecting trade between u and z. Thus, this estimator provides a more reliable estimate of the partial neighbor terror effect that will be used in our counterfactual experiment to simulate the full general equilibrium effect.

How economically meaningful are the estimates of neighbor terror on trade?

Before presenting the results of the counterfactual experiments and some robustness checks, we can back-up ad-valorem tax equivalents from the discrete and continuous neighbor terror estimates of Table (3). These tax-equivalents are borne by the exporter country z due to terrorism in its neighbor countries. In the discrete case, the ad-valorem tax equivalent is computed as $\exp\left(\frac{\widehat{\beta}^D}{1-\sigma}\right) - 1$, where the β values are taken from columns 6 and 7 of Table (3). Using an elasticity of substitution σ of 5,[25] the tax-equivalent increases from 1.5 (with $\widehat{\beta}^D = -0.059$) to 5.2% (with $\widehat{\beta}^D = -0.214$). For the continuous case, $(1 + \text{Proxim}_{uz})^{\left(\widehat{\beta}^C/(1-\sigma)\right)} - 1$ gives the ad-valorem tax equivalent, which increases with the number of incidents, as reported in Table (4). However, when the number of incidents is lower than 4, which represents 85% of the cases (see Table 1), the discrete and continuous measures offer a similar quantitative conclusion that represents a tariff on trade that ranges from 1% to nearly 6%. This effect is much lower than the 30% tariff-equivalent on trade estimated by Blomberg and Hess, 2006 that is related to all forms of conflicts (i.e. the presence of terrorism together with external and internal conflicts). For the sake of comparison, the neighbor terror effect is in the range of the current trade weighted world average most favored nation tariff of approximately 3.8%.[26]

Additionally, we can decompose the elasticity of neighbor terror with respect to imports, as in Equation 21, which is the combination of the trade elasticity (i.e., how imports respond to trade costs ϵ) and the trade cost elasticity (i.e., how trade costs respond to neighbor terror ρ).

$$\beta \equiv \frac{\partial \ln imports}{\partial \ln Proxim\ Terror} = -\frac{\partial \ln imports}{\partial \ln Trade\ Costs} \times \frac{\partial \ln Trade\ Costs}{\partial \ln Proxim\ Terror} = -\epsilon\rho. \quad (21)$$

According to our theoretical CES framework, an elasticity of substitution of 5 considered now in a standard fashion in most of the recent trade literature (see Head and Mayer, 2014) implies a trade elasticity of 4 ($\epsilon = 1 - \sigma$). Armed with the estimate of ϵ and the elasticity of neighbor terror with respect to trade from

[25] This elasticity of substitution is within the range of values estimated in the literature. See, for example, Head and Mayer (2014).

[26] See the World bank WDI databank.

column 9, that is, 0.058, we can perform a simple calculation that implies a trade cost elasticity ρ of 0.012. Thus, a 10% increase in the distance or in neighbor terror increases trade costs by 0.1%, which is a quite a modest increase.

Table 4: Estimated (continuous) ad-valorem tax equivalents of neighbor terror

Number of neighbor incidents (Proxim)	$\widehat{\beta}^C$= -0.058	$\widehat{\beta}^C$= -0.174
1	0.010	0.030
2	0.016	0.047
3	0.020	0.059
4	0.023	0.068
5	0.026	0.075
10	0.034	0.099
15	0.039	0.114
88	0.063	0.177

Notes: Using the continuous measure, ad-valorem tax equivalents are computed as $(1 + \text{Proxim}_{uz})^{\left(\widehat{\beta}^C/(1-\sigma)\right)} - 1$, where the βs estimates are from columns 8 and 9 of Table (3). We use an elasticity of substitution σ of 5.

Robustness checks: before and after 2001

Table 5 presents the results for two interesting sub-periods: 1993-2000 and 2002-2007, that is, before and after 2001. The 9/11 events led potential victim countries not only to increase security measures at their borders but also to enlarge their investigations and track terrorism activity well beyond the borders of the traditional source countries of terror. A quick glance at the cross-country differences in the number of US visas issued to foreign nationals after 9/11 offers dramatic evidence of security measures that started to cover larger areas. After 9/11, almost all of the countries' nationals who wished to migrate or travel for business or tourism experienced a reduction in US visa allowances, but some countries, especially Muslim ones, have been affected at least twice as much as others (Cainkar, 2004, see also Appendix F).

Our results from Table 5 are consistent with this evidence. The incidents of neighbor countries produced 1.5 to 2 times more negative effects on z exports to u after 2001 than prior to 2001.[27]

Table 6 presents the results before and after 2001 of a sub-sample of *a priori* safe z countries. These countries are defined as *a priori* safe because they did not commit any terror activity in the 5 years prior to a time t. However, among

[27]Note that only regressions with exporter-time and importer-time effects are presented here. The results adding the demanding country-pair fixed effects still produce differences in the magnitude between the two sub-periods, which is reassuring, but the significance level of the estimators decreases to approximately 10%.

Table 5: Trade and neighbor terror: before and after 2001

Dependent variable: ln(Industry Exports) from Exporter$_z$ to Destination$_u$ at time t				
	(10)	(11)	(12)	(13)
Shared characteristics of exporter z and neighbor(s) n:[1]	Discrete $\tau^{D}_{uz}(n)$		Continuous $\tau^{C}_{uzt}(n)$	
Period:	Before 2001	After 2001	Before 2001	After 2001
Exporter's neighbor terror against destination$_{uz(n),t}$	**-0.178**^{b}	**-0.296**^{b}	**-0.139**^{b}	**-0.277**^{b}
	(0.070)	(0.120)	(0.067)	(0.110)
Regional trade agreement$_{uz,t}$	0.426^{a}	0.450^{a}	0.426^{a}	0.451^{a}
	(0.049)	(0.062)	(0.049)	(0.062)
Currency union$_{uz,t}$	-0.032	-0.128	-0.023	-0.125
	(0.081)	(0.079)	(0.080)	(0.079)
Ln Distance$_{uz}$	-1.274^{a}	-1.430^{a}	-1.274^{a}	-1.431^{a}
	(0.029)	(0.038)	(0.029)	(0.038)
Common language$_{uz}$	0.667^{a}	0.743^{a}	0.669^{a}	0.746^{a}
	(0.045)	(0.059)	(0.045)	(0.059)
Common land border$_{uz}$	0.779^{a}	0.715^{a}	0.778^{a}	0.715^{a}
	(0.085)	(0.100)	(0.085)	(0.100)
Border effect$_{uz}$	4.289^{a}	3.843^{a}	4.290^{a}	3.842^{a}
	(0.178)	(0.222)	(0.178)	(0.222)
Observations	589,573	244,967	589,573	244,967
R^2	0.661	0.694	0.661	0.694
Fixed Effects:				
Industry (3 digit)	yes	yes	yes	yes
Exporter × Year	yes	yes	yes	yes
Importer × Year	yes	yes	yes	yes

Notes: [1]Relationships between z and n are defined as sharing a border, a language, and a religion. The neighbor terror measure is (1) discrete when measured with a binary variable which is unity if the exporter's neighbor(s) n committed terror incidents against the destination u or (2) continuous when measured with the number of terror incidents of the exporter's neighbor(s) n against the destination u. Heteroskedastic-robust standard errors in parentheses, clustered by exporter-destination pair. ^{a} and ^{b} indicate significance at the 1% and 5% confidence levels, respectively.

these countries, some might have neighbors that have been experiencing terror activity. By running this specification, we are confident that the impact of terror on their trade, if any, would be consistent with a pure negative externality from the neighborhood.

Table 6: Trade and neighbor terror: 'safe' exporter countries[1]

Dependent variable: ln(Industry Exports) from Exporter$_z$ to Destination$_u$ at time t	(14)	(15)	(16)	(17)
Shared characteristics of exporter z and neighbor(s) n:[1]	Discrete $\tau^D_{uz}(n)$		Continuous $\tau^C_{uzt}(n)$	
Period:	Before 2001	After 2001	Before 2001	After 2001
Exporter's neighbor terror against destination$_{uz(n),t}$	**-0.090**	**-0.221**^{b}	**-0.050**	**-0.245**^{b}
	(0.070)	(0.102)	(0.079)	(0.087)
Regional trade agreement$_{uz,t}$	0.382^a	0.426^a	0.382^a	0.426^a
	(0.047)	(0.062)	(0.047)	(0.062)
Currency union$_{uz,t}$	-0.034	-0.124	-0.031	-0.121
	(0.083)	(0.082)	(0.083)	(0.082)
Ln distance$_{uz}$	-1.292^a	-1.440^a	-1.291^a	-1.441^a
	(0.029)	(0.038)	(0.029)	(0.038)
Common language$_{uz}$	0.646^a	0.719^a	0.646^a	0.720^a
	(0.045)	(0.060)	(0.046)	(0.060)
Common land border$_{uz}$	0.808^a	0.766^a	0.809^a	0.766^a
	(0.089)	(0.102)	(0.089)	(0.102)
Border effect$_{uz}$	4.107^a	3.862^a	4.109^a	3.860^a
	(0.338)	(0.444)	(0.165)	(0.225)
Observations	565,052	238,452	565,052	238,452
R^2	0.652	0.687	0.652	0.687
Fixed Effects:				
Industry (3 digit)	yes	yes	yes	yes
Exporter × Year	yes	yes	yes	yes
Importer × Year	yes	yes	yes	yes

Notes: [1]"Safe" exporter countries are defined as exporter countries that did not commit any terror incident in the 5 years prior to a time t. [2]Relationships between z and n are defined as sharing a border, a language, and a religion. The neighbor terror measure is (1) discrete when measured with a binary variable which is unity if the exporter's neighbor(s) n committed terror incidents against the destination u or (2) continuous when measured with the number of terror incidents of the exporter's neighbor(s) n against the destination u. Heteroskedastic-robust standard errors in parentheses, clustered by exporter-destination pair. ^{a} and ^{b} indicate significance at the 1% and 5% confidence levels, respectively.

The results show a non-significant impact of neighbor terror on the exports of safe countries before 2001 (col. 1 and 3). In sharp contrast, after 2001, the estimates of neighbor terror become statistically significant and higher in magnitude (col. 2 and 4). This result has two interesting and important implications. First, focusing on relatively safe countries offers a good alternative to check the robustness of our results. Second, it reveals *a priori* that some safe countries that have not been involved in terrorism and were not affected by neighbor terror before 9/11are now likely considered as potential hosts for new terrorist cells.

Robustness checks: differentiated versus non differentiated industries

Finally, we present a last robustness check in Table 7. We split our sample of ISIC industries into three groups according to the Rauch (2001)'s classification of differentiated products. Rauch sets-up the classification at the 4digit SITC product level, where he classifies products into (relatively) homogenous products (i.e. those delivered by organized exchange markets or where information on prices is readily avialable from specialized magazines) and differentiated products (i.e. those that were identified not to be in the latter categories). Using a concordance list between SITC and ISIC industries, we have computed the share of 4-digits SITC differentiated products involved in each 3-digits ISIC industries we use. Where the share was above 50% we have classified the industry as to produce a high proportion of differentiated products. When it was between 20 and 50%, the industry was classified as to produce a mid-proportion of differentiated products. Finally, where the share was under 20% we have classified the industry as to produce a low proportion of differentiated products. Thus, industries were classified into 3 classes of products' differentiation according to Rauch (2001): Low-differentiation ($r = 0$), Mid-differentiation ($r = 0.5$) and High-differentiation ($r = 1$).

The results are very much consistent with those of Table 3. The magnitudes of the estimates of the neighbor terror vary with the addition of the country-pair fixed effects. The estimates of the neighbor terror are relatively lower in columns (21) and (25) than in columns (18) and (22), respectively. Without the country-pair fixed effects and given the standard errors, the estimates do not appear to be statistically different from one another across the groups of industries. However, the addition of the country-pair fixed effects changes the picture. The estimates of the neighbor terror are only significant in the sub-sample of industries producing high-differentiated products (col. 21 and 25). They are not significant in industries producing lower proportions of differentiated products ($r = 0.5$ and $r = 0$). The latter results are available upon request. Interestingly, the magnitudes of the neighbor terror estimates in columns (21) and (25) are similar to the ones in columns (7) and (9), respectively (see Table 3). These results suggest, intuitively, that the neighbor terror effect on trade is taken place a priori in the industries producing usually highly differentiated products.

Table 7: Trade and neighbor terror at the industry level

Dependent variable: ln(Industry Exports) from Exporter$_z$ to Destination$_u$ at time t	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
Shared characteristics of exporter z and neighbor(s) n:[1]	Discrete $\tau^D_{uz}(n)$				Continuous $\tau^C_{uzt}(n)$			
Type of product differentiation[2]	$r=0$	$r=.5$	$r=1$	$r=1$	$r=0$	$r=.5$	$r=1$	$r=1$
Exporter's neighbor terror against Destination$_{uz(n),t}$	**-0.264**^{a}	**-0.301**^{a}	**-0.157**^{b}	**-0.058**^{b}	**-0.176**^{b}	**-0.233**^{a}	**-0.142**^{b}	**-0.043**^{c}
	(0.101)	(0.082)	(0.068)	(0.029)	(0.088)	(0.073)	(0.060)	(0.026)
Regional trade agreement$_{uz,t}$	0.515^a	0.457^a	0.406^a	0.222^a	0.516^a	0.457^a	0.406^a	0.217^a
	(0.052)	(0.049)	(0.063)	(0.026)	(0.063)	(0.049)	(0.052)	(0.023)
Currency union$_{uz,t}$	-0.209^b	0.015	-0.050	0.024	-0.201^b	0.026	-0.046	0.016
	(0.097)	(0.074)	(0.082)	(0.036)	(0.097)	(0.074)	(0.082)	(0.035)
Log distance$_{uz}$	-1.451^a	-1.380^a	-1.265^a		-1.450^a	-1.380^a	-1.266^a	
	(0.042)	(0.028)	(0.033)		(0.042)	(0.028)	(0.033)	
Common language$_{uz}$	0.642^a	0.592^a	0.748^a		0.643^a	0.594^a	0.750^a	
	(0.062)	(0.050)	(0.048)		(0.048)	(0.050)	(0.062)	
Common land border$_{uz}$	0.815^a	0.782^a	0.732^a		0.815^a	0.781^a	0.731^a	
	(0.106)	(0.085)	(0.091)		(0.106)	(0.085)	(0.091)	
Border effect$_{uz}$	3.890^a	4.062^a	4.279^a		3.894^a	4.064^a	4.278^a	
	(0.219)	(0.182)	(0.191)		(0.219)	(0.182)	(0.191)	
Observations	112,407	246,103	476,030	476,030	112,407	246,103	476,030	476,030
R^2	0.684	0.636	0.709	0.726	0.684	0.636	0.709	0.766
Fixed Effects:								
industry (3 digit)	yes	yes	yes	yes	yes	yes	yes	yes
Exporter × Year	yes	yes	yes	yes	yes	yes	yes	yes
Importer × Year	yes	yes	yes	yes	yes	yes	yes	yes
Exporter × Importer	-	-	-	yes	-	-	-	yes

Notes: [1] Relationships between z and n are defined as sharing a border, a language, and a religion. The neighbor terror measure is defined as (1) discrete when measured with a binary variable, which is unity if exporter's neighbor(s) n committed terror incidents against destination u or (2) continuous when measured with the number of terror incidents of the exporter's neighbor(s) n against the destination u. [2] The industries are classified into $r = 1$ (Highly differentiated products' industries), $r = 0.5$ (Mid-differentiation products' industries) and $r = 0$ (Low-differentiation ones). [3] Heteroskedastic-robust standard errors in parentheses, clustered by exporter-destination pair. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels, respectively.

3.3 A non-monotonic effect of the proximity to terrorism on trade

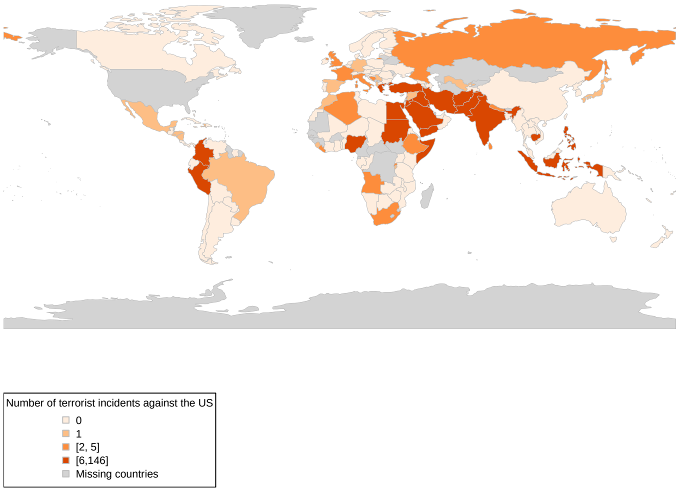
Proposition (4) highlights an interesting non-monotonic effect of increased security, whereby (1) neighbors near a terrorist incident have trade reduced by enhanced security measures through an increase in the cost of trade, while (2) countries located farther away benefit from the relative cheapening of their goods due to the increased security in the inward multilateral resistance of the victim country. We empirically examine this non-monotonic effect through changes in trade costs and multilateral resistances following a positive shock in neighbor terror.[28] In reaction to a terror shock, victim countries increase their security measures both against source countries of terrorism and their neighbors, where a terrorist cell can be potentially implemented. Imposing security measures against people and goods, such as security checks, time delays, restrictions on visa allowances to business people, and immigration controls, is likely to increase trade costs and thus reduce trade.

For tractability reasons, Proposition (4) has been derived with a continuum of exporting countries that potentially host terrorist cells and one importing country. In this section, we move closer to the model and design our counterfactual experiment to isolate the effect of neighbor terror against one importing victim country, namely, the US. This choice is empirically motivated by several facts. First, the US has been by far the country that was most targeted by transnational terrorism attacks during our period of investigation (see Table 9). Additionally, the attacks targeted its representative authorities (e.g., US embassies), its army or its civilians. Moreover, the distribution of incidents against the US is spread over a large number of different source countries around the world that are not located only in the Middle East region. This pattern is depicted in Figure 9.[29] Finally, during our period of investigation, 40 exporter countries in our sample had neighbors perpetrating incidents against the US, while 11 of them did not perpetrate any direct incident against the US. The US typically reacts to terrorism and adapts its expectations by profiling its security measures against the source and neighbor countries of terror. We thus use the cross-country variation in neighbor terror to investigate the full general effect of neighbor terror on US imports.

[28]We focus on changes in the trade cost friction ratio (see Eq. 12); furthermore, for simplification, we abstract analyzing any potential feedback effect on the frictionless trade ratio.

[29]The figure 9 depicts the total number of terrorist incidents against the US between 1993 and

Figure 9: Transnational terrorism against the United States (1993-2006)



The non-monotonic effect of neighbor terror on trade is investigated through changes in the estimated trade cost friction ratio ($\widehat{T}_{uz}/\widehat{P}_u\widehat{\Pi}_z$) comprising bilateral trade costs as well as outward (OMR) and inward (IMR) multilateral resistances. We first work out trade costs and OMR changes, as in Proposition (4). Then, we allow for IMR changes by considering how other importing countries react to the shock of neighbor terror against the US.

The multilateral resistances are calculated by solving the system of equations (13) - (14).[30] Ideally, we would like to solve this system year by year, but we would need annual data on industry-country expenditure (E_{zt}) and output (Y_{zt}). Unfortunately, we lack such data for a large number of countries and industries, especially for the developing countries where transnational terrorism is prevalent. Thus, to keep a maximum number of countries in our sample, we average the manufacturing expenditure and output over the period of 1993-2006 at the country level. This approach allows us to keep 112 countries out of the initial 113 countries in our sample. We thus solve the following system:

$$\widehat{OMR}_z = \widehat{\Pi}_z^{1-\sigma} = \sum_u \left(\frac{\widehat{T}_{uz}}{\hat{P}_u}\right)^{1-\sigma} \bar{s}_u^E, \tag{22}$$

2006 based on the ITERATE data set.

[30]We thank Scott Baier for providing us a draft of the R code to solve this system.

$$\widehat{IMR}_u = \widehat{P}_u^{1-\sigma} = \sum_z \left(\frac{\widehat{T}_{uz}}{\widehat{\Pi}_z} \right)^{1-\sigma} \bar{s}_z^Y, \tag{23}$$

where $\bar{s}_z^Y$ is country z's average share of the world manufacturing output and $\bar{s}_u^E$ is country u's share of the world manufacturing spending. We also compute the estimated bilateral trade costs ($\widehat{T}_{uz}$) over the period of 1993-2006 as follows:

$$\widehat{T}_{uz}^{1-\sigma} = \exp\left(\widehat{\lambda}_1 \overline{RTA}_{uz} + \widehat{\lambda}_2 \overline{CU}_{uz} + \widehat{\beta}^C \ln(1 + \overline{Proxim}_{uz}(n)) + \widehat{\alpha}_{uz} \right), \tag{24}$$

where $\widehat{\lambda}_1, \widehat{\lambda}_2, \widehat{\beta}^C, \widehat{\alpha}_{uz}$ are estimates of equation (16).[31] The first three estimated parameters are reported in column 9 of Table (3). The variables $\overline{RTA}$, $\overline{CU}$ and $\overline{Proxim}$ are redefined over the period of 1993-2006. $\overline{RTA}$ and $\overline{CU}$ are set to be equal to unity if the two countries share an agreement or a currency during at least seven years over the fourteen-year period. Then, we construct the $\overline{Proxim}$ variable by averaging the number of terrorist incidents perpetrated by the neighbors' exporter against the importer between 1993 and 2006 for each country pair.[32]

Results of the counterfactual experiment. We analyze two counterfactual experiments. First, what would be the level of US imports in the absence of neighbor terror against the US? Second, what would be the level of US imports when doubling the number of neighbor incidents? Although these are obviously extreme counterfactual scenarios, we view them as useful benchmarks that can shed light on the quantitative importance of neighbor terror.

Armed with our gravity estimates shown in column 9 in Table 3, we first work out the changes in trade costs and multilateral resistances in the absence of neighbor terror against the US. We find that US imports from the 40 countries experiencing neighbor terror would be 4.3% higher on average in the absence of such violence.

Then, we study the counterfactual scenario of doubling the number of neighbor terrorism incidents against the US. This experiment confirms the interesting non-monotonic effect of terror on trade that we decompose in three parts corresponding to the three arguments of the trade cost friction ratio ($\widehat{T}_{uz}, \widehat{P}_u$ and $\widehat{\Pi}_z$). First, doubling the number of incidents increases the bilateral trade costs ($\widehat{T}_{uz}$)

[31] Since our approach computes $\widehat{T}_{uz}, \widehat{P}_u, \widehat{\Pi}_z$ inclusive of σ, we do not need to take a stance on the value of the elasticity of substitution.

[32] Here, we define neighbor relationships based on the sharing of a border, a language and a religion between countries.

of the 40 countries with neighbor terror and further reduces their exports to the US by 2.1% on average. This implies that with a trade elasticity of 4 (see above), trade costs would be on average approximately 0.5% higher on average due to increased security measures.

Second, the change in $\widehat{T}_{uz}$ induced by neighbor terror actually modifies the outward and inward multilateral resistances for all countries, i.e., their buyer and seller incidence (see Anderson and Yotov, 2010). Thus, if one considers the whole set of observable U importing and Z exporting countries in the world, then one obtains a new set of $\hat{P}_u$ and $\hat{\Pi}_z$, $\forall u \in [1, U]$ and $\forall z \in [1, Z]$. These new figures then enter equations (22) and (23) and provide new estimates for the US inward multilateral resistance and the outward multilateral resistance for each of its partners z. By doing so, we find that a doubling of the number of neighbor incidents increases the US inward multilateral resistance ($\widehat{P}_u$) and, with all other factors held equal, increases *bilateral* US imports by approximately 0.5%. This benefits *all* exporters (including the unsafe ones) but does not offset the above 2.1% decrease in exports faced by the 40 countries experiencing neighbor terror. In contrast, the 71 safe countries increase their exports to the US by benefiting from the relative cheapening of their goods due to the rise in the US IMR. By further accounting for changes in the $OMRs$, doubling the number of neighbor incidents reduces the exports of the 40 unsafe countries to the US by 1.8% overall.[33]

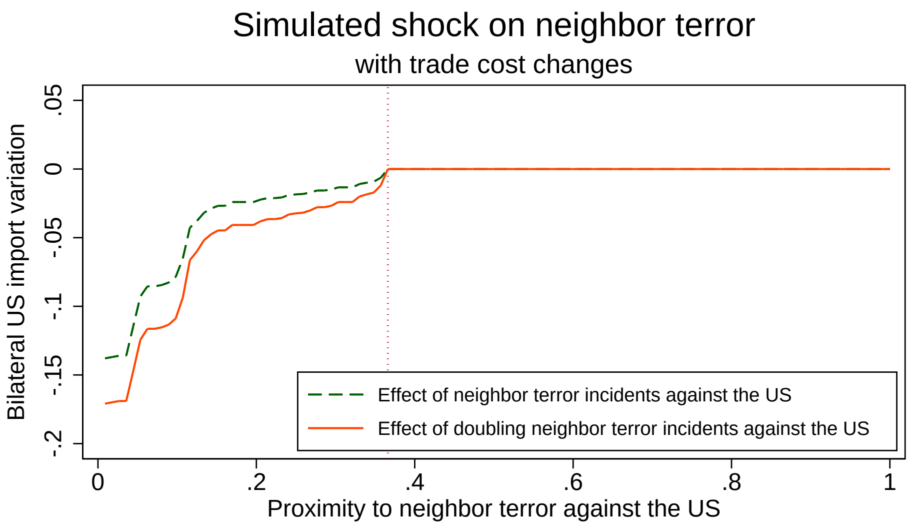
The trade cost and multilateral resistance changes can also be decomposed graphically. They will show some heterogeneity across countries. Figure (10) plots the variation in bilateral US imports versus proximity to neighbor terror. A total of 111 countries are ranked according to their proximity to neighbor terror, and 40 countries to the left of the vertical line enact neighbor terrorism against the US. They face higher trade costs and export less to the US (the dashed line) than the 71 countries to the right of the vertical line with no neighbor terror against the US. The proximity to terror is normalized between 0 and 1, with 0 corresponding to the country with the highest average number of neighbor incidents against the US between 1993 and 2006. Consequently, it faces the largest spillover effects on its trade, i.e., a 13.8% decrease in US imports compared with a country with no neighbor terror.

Let us now investigate the effects of the neighbor terror shock graphically, i.e.,

[33]Figures for the whole sets of IMRs and OMRs are available upon request.

doubling the average number neighbor terror incidents against the US. Again, we first consider only bilateral trade cost changes, that is, the variation in $\widehat{T}_{uz}$. Recall that doubling the number of neighbor terror incidents further reduces US imports by 2.1% on average with some variations represented by the solid red line.

Figure 10: Non-monotonic effect of neighbor terror against the US (part I)

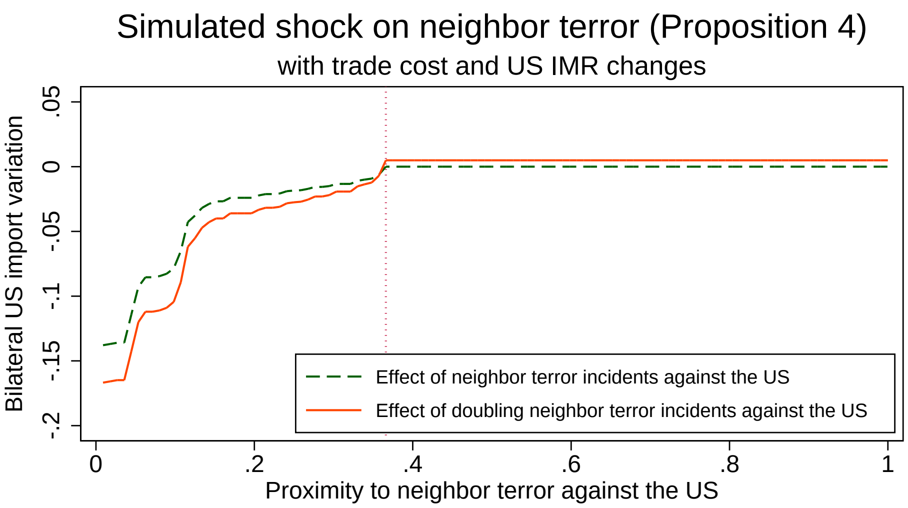


Notes: Proposition 4 is simulated with trade cost changes only. A total of 111 export countries are ranked according to their proximity to neighbor terror, which is computed based on the average number of neighbor terror incidents against the US between 1993 and 2006. The 40 countries to the left of the vertical line enact neighbor terror against the US. They face higher trade costs and export less to the US (the dashed line) than the 71 countries to the right with no neighbor terror against the US. The solid (red) line represents the effect of doubling the average number of neighbor terror incidents against the US.

Figure (11) adds the second part of the non-monotonic effect, i.e., the change in the US IMR following the terror shock. As expected, this change benefits all exporters, and the dashed line is shifted up compared with Figure (10). In other words, the distance between the dashed and the solid lines is now smaller for the 40 countries with neighbor terror (to the left of the vertical line), while the 71 countries with safe neighbors have increased their exports to the US. Figure (11) remarkably mimics the bottom of Figure (7) derived theoretically from Proposition (4) (where the US is the only importing country and exporters' OMR changes cannot be considered).

We can also compute the additional change in exporters' OMR and IMR when doubling the number of neighbor terrorism incidents against the US. The three changes in the non-monotonic effect of neighbor terror are thus represented by the solid red line in Figure (12). Recall that changes in exporters' OMR and IMR are absent from our theory because we considered only one importing country to build a tractable general equilibrium model. The empirical multi-country model allows for the response of partners' costs or their complementary multilat-

Figure 11: The non-monotonic effect of neighbor terror against the US (2nd part)



Notes: IMR stands for Inward Multilateral Resistance. Proposition 4 is simulated with trade cost and IMR changes. A total of 111 export countries are ranked according to their proximity to neighbor terror, which is computed based on the average number of neighbor terror incidents against the US between 1993 and 2006. The 40 countries to the left of the vertical line enact neighbor terror against the US. They face higher trade costs and export less to the US (the dashed line) than the 71 countries to the right with no neighbor terror against the US. The solid (red) line represents the effect of doubling the average number of neighbor terror incidents against the US.

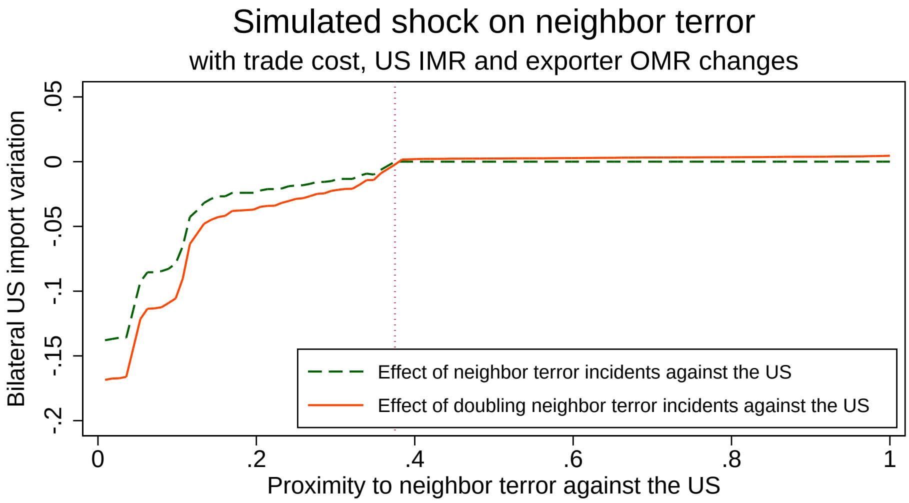
eral resistances to increases in security measures directed at neighbors adjacent to terrorist perpetrators. This figure confirms the interesting non-monotonic effect of increased security, whereby neighbors near a terrorist incident have trade reduced by enhanced security measures, while countries situated farther away benefit from the relative cheapening of their goods due to the security-induced increase in the inward multilateral resistance of the US.

4 Conclusions

In this paper, we examined the impact of the location of transnational terrorism on security and international trade. To counter the location of transnational terrorism, because of imperfect knowledge regarding the precise location of a potential incident, governments implement comprehensive security measures across regions. 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 established a simple theoretical model predicting an interesting non-monotonic effect, i.e., the closer a country is to a source of terrorism, the higher the negative spillover effect on its trade. In contrast, countries located far from terror could benefit from an increase in security through additional trading. We investigate

Figure 12: The non-monotonic effect of neighbor terror against the US (3rd part)



Notes: OMR and IMR stand for Outward and Inward Multilateral Resistances, respectively. We simulate Proposition 4 with trade cost, OMR and IMR changes.A total of 111 export countries are ranked according to their proximity to neighbor terror, which is computed based on the average number of neighbor terror incidents against the US between 1993 and 2006. The 40 countries to the left of the vertical line enact neighbor terror against the US. They face higher trade costs and export less to the US (the dashed line) than the 71 countries to the right with no neighbor terror against the US. The solid (red) line represents the effect of doubling the average number of neighbor terror incidents

the empirical validity of these implications with a large data set of international trade relationships and transnational terrorist incidents over the period of 1993-2006. We find a partial negative impact of transnational terrorism on trade and confirm the non-monotonic general equilibrium effect of neighbor terror on trade.

Obviously, our analysis of the location of global terrorism on trade left out a number of issues that would be worth investigating in future research. First, our model does not allow for sequential learning effects on the side of the target country's government. Typically, over time, the authorities of a potential target country may refine their knowledge of the likelihood of the locations of terrorist cells across the region. Hence, some screening could be undertaken that would allow the target government to more precisely fine-tune its security policy. As such, this would reduce the informational problems that are at the heart of the trade spillover effects on 'potentially unsafe countries'. Obviously, such security policy screening would be possible only if the terrorist network is not very flexible in its capacity to relocate across the region, which may be difficult to assess in fragile regions characterized by porous (and difficult to monitor) borders.

Additionally, in our analysis of the impact of terrorist networks on bilateral trade flows, we followed the classical view that terror incidents tend to affect trade flows through a change in transaction costs. As mentioned by Bandyopadhyay et al. (2014), terror incidents may also affect trade through other mechanisms. One may have general equilibrium effects of resource reallocations across more-or-less vulnerable sectors of the economy. Additionally, migration flows of political refugees could facilitate the relocation of terrorist cells across borders. How this would interact with the informational externality that we highlight would be worth examining both from the perspective of the potential unsafe countries and from the perspective of the target economies.

Finally, given the transnational externalities generated by terrorist networks, it would be natural to extend the framework to discuss the possibility of coordination and cooperation on security and trade policy matters between target countries and their trade partners. Specifically, a "potential unsafe but still secure" country could have some interest to cooperate with a potential target government on counter-terrorism policies in exchange for a more lenient security policy on its trade flows to that target country. The interactions with other policy instruments, such as foreign aid and military assistance, may also contribute to the internalization/reduction of these spillover effects. An analysis of these issues on how global terrorism shapes international trade flows and more generally the globalization process is certainly beyond the scope of the present paper. We hope that the framework sketched here can be a useful stepping stone for future research in that direction.

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Appendices

A Existence of the Bayesian Nash equilibrium

A Bayesian Nash equilibrium $\left(S_z^N, \theta_z^N\right)$ of the terrorism-security game is 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

$$\widetilde{T}^{1-\sigma} = \left(L_u T_{uu}^{1-\sigma} + L \int_0^1 T(S_z^N)^{1-\sigma} uz\right).$$

Inspection of Figure 3b shows that $S(\widetilde{T}, z)$ is decreasing in $\widetilde{T}$ while $\widetilde{\theta}\left(\widetilde{T}, z\right)$ is increasing in $\widetilde{T}$.[34] From this, it follows that

$$\begin{aligned} H(\widetilde{T}) &= L_u T_{uu}^{1-\sigma} + L \int_0^1 T(S_z)^{1-\sigma} uz \\ &= L_u T_{uu}^{1-\sigma} + L \int_0^1 T(S(\widetilde{T}, z))^{1-\sigma} uz, \end{aligned}$$

[34]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).

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

$$\widetilde{T}^{1-\sigma} = H(\widetilde{T}). \tag{25}$$

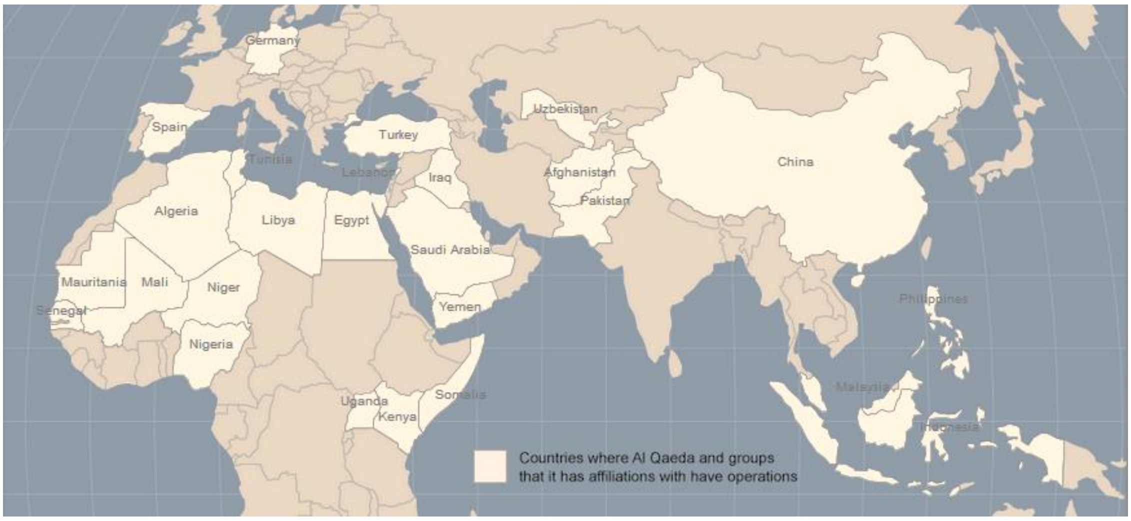
The left hand side of this equation is a decreasing function of $\widetilde{T}$ (for $\sigma > 1$) going from $+\infty$ to 0 as $\widetilde{T}$ goes from 0 to $+\infty$. As $H(\widetilde{T})$ is an increasing function of $\widetilde{T}$ with $H(0) \geq 0$ and $\lim_{\widetilde{T}\to\infty} H(\widetilde{T}) > 0$, it follows that equation (25) 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 $z \leq \widetilde{z}$.

B Data sources

The study covers the period 1993-2006. To run our analysis, we use a constructed data set from de Sousa, *et al.* (2012) of 26 International Standard Industrial Classification (Revision 2) 3-digit industries, 113 exporting countries and 113 importing countries. The data sets provides bilateral trade and production figures in a compatible industry classification for developed and developing countries. Manufacturing expenditures (absorption) are calculated as total production plus imports minus exports. Data on distance, contiguity and language come from the CEPII (http://www.cepii.fr/anglais-graph/bdd/distances.htm).

C Terrorism figures

Figure 13: Al Qaeda and affiliated groups



Source: http://www.nytimes.com/interactive/2011/05/12/world/12aqmap.html

D Source countries of terrorism

Table (8) lists the source countries of transnational terrorism from 1993 to 2006.

Table 8: Source countries of transnational terrorist incidents by income level

High	# of incidents	Upper-middle	# of incidents	Lower-middle	# of incidents	Low	# of incidents
Australia*	2	Argentina*	2	Albania*	10	Afghanistan	29
Austria*	1	Bahrain	7	Algeria*	57	Angola	26
Belgium and Lux.*	1	Brazil*	2	Bolivia*	1	Azerbaijan*	2
Cyprus*	1	Chile*	1	Bosnia-Herzegovina	14	Burundi	6
Denmark*	1	Croatia	1	China*	14	Bangladesh*	1
France*	9	Gabon*	1	Colombia*	224	Côte d'Ivoire*	1
Germany*	14	Korea*	2	Costa Rica*	1	Congo	2
Greece*	27	Lebanon*	8	Cuba	8	Ethiopia*	9
Ireland*	8	Malaysia*	1	Dominican Rep.	1	Georgia*	6
Israel*	4	Mexico*	2	Ecuador*	2	Haiti*	2
Italy*	14	Poland*	1	Egypt*	42	Indonesia*	28
Japan*	4	Saudi Arabia*	35	El Salvador*	5	India*	17
Kuwait*	9	Slovakia*	1	Guatemala*	6	Cambodia*	31
Netherlands*	1	South Africa*	5	Honduras*	2	Liberia	8
Norway*	1	Trinidad-Tobago*	1	Iran*	40	Mali	1
Portugal*	1	Uruguay*	1	Iraq*	68	Burma	5
Singapore*	2	Venezuela*	4	Jamaica	1	Nigeria*	32
Spain*	14			Jordan*	15	Nicaragua	7
Sweden*	1			Latvia*	1	Nepal*	4
Taiwan*	2			Macedonia*	1	Pakistan*	52
U.A. Emirates	1			Morocco*	9	Rwanda*	7
U.S.A*	5			Papua New Guinea	1	Sudan*	13
United Kingdom*	14			Peru*	15	Sierra Leone*	29
				Philippines*	36	Somalia	61
				Romania*	1	Chad	2
				Russia*	19	Togo	1
				Serbia-Montenegro	5	Tajikistan*	5
				Sri Lanka*	19	Uganda*	6
				Syria*	5	Ukraine*	2
				Tunisia*	1	Uzbekistan	4
				Turkey*	129	Yemen*	48
						Zimbabwe*	1
						Palestine	88
Total: 23	137	17	75	31	753	33	536

Note: The study covers the period 1993-2006. The star indicates the countries in the sample for estimation. High, Upper-middle, Lower-middle and Low refer to the World Bank classification of countries by income level in 2001. # of incidents: number of incidents from the source country. See the text for details about how we code a source country of terror.

E List of industries and countries in the estimation sample

Table (9) reports the list of countries in the estimation sample by income level and the number of transnational terrorist suffered. Then, Table (10) reports the list of the ISIC 3-digit industries in our sample.

Table 9: Countries in the estimation sample by income level and suffered transnational terrorist incidents (1993-2006)

High income	# of incidents suffered	Upper-middle income	# of incidents suffered	Lower-middle income	# of incidents suffered	Low income	# of incidents suffered
Australia	18	Argentina†	7	Albania	3	Armenia	0
Austria*	7	Brazil	9	Algeria†	4	Azerbaijan	1
Bahamas	0	Chile†	3	Bolivia†	3	Benin	0
Belgium and Lux.†	26	Czech Republic	1	Bulgaria	13	Bangladesh	7
Canada	26	Estonia	1	China	20	Côte d'Ivoire	0
Cyprus	0	Gabon	0	Colombia†	11	Eritrea	0
Denmark	6	Hungary	10	Costa Rica*	2	Ethiopia	4
Finland	2	Korea	15	Ecuador†	3	Georgia	1
France†	120	Lebanon†	3	Egypt†	9	Ghana	1
Germany†	25	Malaysia	4	El Salvador	4	Gambia	1
Greece	15	Malta	1	Fiji	2	Haiti	0
Hong Kong	0	Mexico†	10	Guatemala†	5	Indonesia	9
Ireland	9	Oman*	1	Honduras†	0	India	41
Israel	66	Panama*	5	Iran†	9	Kenya*	3
Italy	86	Poland	14	Iraq†	3	Cambodia	0
Japan	22	Saudi Arabia†	6	Jordan†	7	Laos	0
Kuwait†	0	Slovakia†	2	Latvia	1	Mozambique	1
Netherlands*	23	South Africa	10	Macedonia	0	Malawi	1
New Zealand	4	Trinidad-Tobago	0	Morocco†	4	Niger*	0
Norway	8	Uruguay†	7	Paraguay*	2	Nigeria	5
Portugal	6	Venezuela*	28	Peru†	2	Nepal	4
Singapore	2			Philippines	17	Pakistan	3
Slovenia	1			Romania	6	Rwanda†	1
Spain	29			Russia	38	Sudan†	4
Sweden	8			Sri Lanka	5	Sierra Leone	0
Switzerland*	23			Suriname	0	Tajikistan	0
Taiwan	3			Syria†	0	Tanzania	1
U.S.A	819			Thailand	11	Uganda†	0
United Kingdom	176			Tunisia†	1	Ukraine	6
				Turkey	169	Viet Nam	0
						Yemen†	0
						Zambia	1
						Zimbabwe	0
Total: 29	1530	21	137	30	354	33	95

Notes: Our sample includes 113 countries. High, Upper-middle, Lower-middle and Low refer to the World Bank classification of countries by income level in 2001. # of incidents: reports the number of incidents recorded and suffered by the victim country. See the text for details about how we code a victim country. The † indicates the countries with both direct and neighbor terror against the US. The * indicates the countries with neighbor terror against the US but no direct incidents against the US.

Table 10: List of the 26 ISIC 3-digit industries

Code	ISIC (International Standard Industrial Classification) Rev. 2
31	**Food, Beverages and Tobacco**
311-312	Food
313	Beverage
314	Tobacco
32	**Textile, Wearing Apparel and Leather Industries**
321	Textiles
322	Wearing apparel, except footwear
323	Leather and products of leather, leather substitutes and fur
324	Footwear, except vulcanized or moulded rubber or plastic footwear
33	**Wood and Wood Products, Including Furniture**
331	Wood and cork products, except furniture
332	Furniture and fixtures, except primarily of metal
34	**Paper and Paper Products, Printing and Publishing**
341	Paper and paper products
342	Printing, publishing and allied industries
35	**Chemicals and Chemical, Petroleum, Coal, Rubber and Plastic Products**
351	Industrial chemicals
352	Other chemical products
353	Petroleum refineries
355	Rubber products
356	Plastic products not elsewhere classified
36	**Non-Metallic Mineral Products, except Products of Petroleum and Coal**
361	Pottery, china and earthenware
362	Glass and glass products
369	Other non-metallic mineral products
37	**Basic Metal Industries**
371	Iron and steel basic industries
372	Non-ferrous metal basic industries
38	**Fabricated Metal Products, Machinery and Equipment**
381	Fabricated metal products, except machinery and equipment
382	Machinery except electrical
383	Electrical machinery apparatus, appliances and supplies
384	Transport equipment
385	Professional and scientific, and measuring and controlling equipment not elsewhere classified, and of photographic and optical goods

F Terror and business visas allowance

In lieu of direct measures of increased security, we use observable terrorist incidents that are assumed (backed by the theory) to induce increased security targeted at the source country of terrorism and their neighbors. This reasonable assumption is supported by evidence linking visa allowances with terror incidents.

For our period of study, we could have access to business visas issuance by the US across country partners. In particular, the US Department of State releases on its website data since 1997.[35] The question we ask in this appendix is whether or not terrorism activities, and especially those from neighboring countries, are affecting business visa issuance. And if so, is the effect being reinforced after 9/11?

We chose to work on the number of visas issued by the US for Business (B1) and

[35]The UK Home Department also delivers data regarding entry visas into the UK. However, the data is observed since 2003 only. By pooling both the US and UK data with got quite similar results, which are available upon request. However, we focus here only on the US data as we can use them to test the change in the security measures (visas delivery) before and after 2001

Business and Leisure (B1-2).[36] Recent studies have shown the importance of face-to-face in international trade relationships and the implied impact of business visas on trade in differentiated products (see Cristea, 2011). Note that only citizens of countries that are not part of the Visa Waiver Program are included in our analysis. Hence, this excludes most of the OECD countries that are part of this program. OECD nationals do not need visas in general to enter the US for Business or Leisure for a short stay (under 3 months).

Table 11 shows the results for a series of regressions where the log of bilateral US Business Visas are regressed over gravity-like variables (distance, RTA and common language), together with variables related to terrorism.[37] We begin by using a variable indicating terror incidents from country z targeting the US (i.e., bilateral terror), to which we add another variable revealing the existence of terror incidents by countries neighboring z (i.e., neighbor terror). Specifications 1 to 7 of Table 11, are quite comparable to those from Table 2 on trade flows. Column 1 includes the terror variable against the US, a year fixed effect to control for US specific changes over time, and gravity-type variables without other controls. The effect of bilateral terror is not statistically significant. In column 2, we add-up a first measure of neighbor terror based on neighbors' sharing a border with country z (i.e., which we call the B measure of neighbor terror, see description and discussion of alternative measures of neighbor terror in the heart of the paper). Again no statistically significant effect is retrieved here for both bilateral and neighbor terrorism measures.

However, as for trade flows, when neighbors are defined as sharing a border and a language (i.e, the BL measure), or a border, a language and a religion (i.e., the BLR measure), the presence of terror located in these neighboring countries has a negative and statistically significant effect on visa issuance by the US (see columns 3 and 4). Nevertheless, this effect does not appear to be robust to the inclusion of a receiver-visa (exporter) country fixed effect. By contrast, the bilateral terror estimate appears to be negative and statistically significant due to the introduction of the country fixed effect. This suggests than on average over the period 1997-2007, a shock of terrorism by organizations from country z against the US reduces the issuance of visas to its citizens. In column 6, we look at how terror is affecting visa issuance before and after 2001. Strikingly, again while controlling for year and country fixed effects, both bilateral terror and neighbor terror variables appear to have statistically negative effects on visas after 2001 (compared to before). We run an F-test that suggested to constrain these estimators to be equal.[38] In column 7, we run the same specification than in column 6 while accounting for the latter constraint. We find that an increase in terror against the US that originates either from country z or any other neighboring country after 2001, reduces by around 24% visa issuance by the US (i.e. $\exp(0.22)$) Finally, in column 8, using alternatively a continuous measure of terrorism, we find qualitatively similar results. An increase by 10% of either of neighbor terrorism incidents appears to reduce by 0.8% US visa issuance.

[36] We assume that those who come for both Business and Leisure decide to do so primarily for business activities.

[37] The terror variables are defined in Sub-section 3.1.

[38] F(1,65)=0.10 with P-value=0.75

Table 11: Terror and business visas issuance from the US (1997-2007)

	Dependent variable: ln(Business Visas) from the US to exporter$_z$ at time t							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Discrete forms						Continuous form
Shared characteristics of exporter z and neighbor(s) n:[1]		B	BL	BLR	BLR	BLR	BLR	
Exporter's neighbor terror against the US$_{z(n),t}$		-0.113	-0.423^c	-0.569^b	-0.007	0.160	0.149	0.030
		(0.152)	(0.213)	(0.218)	(0.109)	(0.126)	(0.125)	(0.103)
Exporter's neighbor terror against the US$_{z(n),t}$, after 2001						-0.246^b	-0.221^b	-0.087^c
						(0.121)	(0.093)	(0.053)
Terror against the US$_{z,t}$	-0.102	-0.101	-0.051	-0.025	-0.104^c	0.027	0.041	-0.060
	(0.115)	(0.113)	(0.110)	(0.108)	(0.061)	(0.104)	(0.093)	(0.063)
Terror against the US$_{z,t}$ after 2001						-0.198^c	-0.221^b	-0.087^c
						(0.110)	(0.093)	(0.053)
Regional trade agreement with the US$_{z,t}$	0.421	0.469	0.416	0.451^c	-0.228^b	-0.138	-0.144	-0.098
	(0.300)	(0.329)	(0.270)	(0.270)	(0.102)	(0.131)	(0.135)	(0.182)
Ln distance to the US$_z$	-1.124^a	-1.143^a	-1.171^a	-1.264^a				
	(0.283)	(0.288)	(0.278)	(0.291)				
Common language with the US$_{z,t}$	1.102^a	1.078^a	1.208^a	1.198^a				
	(0.161)	(0.147)	(0.173)	(0.162)				
Observations	516	516	516	516	500	500	516	516
R^2	0.818	0.819	0.829	0.834	0.974	0.975	0.975	0.975
Fixed Effects:								
Year$t$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Visa Receiver (exporter)$_z$	No	No	No	No	Yes	Yes	Yes	Yes

Notes: [1]Relationships between z and n are defined as sharing a border, a language, and a religion. The neighbor terror measure is defined as (1) discrete when measured with a binary variable, which is unity if exporter's neighbor(s) n committed terror incidents against the US or (2) continuous when measured with the number of terror incidents of the exporter's neighbor(s) n against the US. Heteroskedastic-robust standard errors in parentheses, clustered by Visa Receiver country, with ^{a}, ^{b} and ^{c} denoting significance at the 1%, 5% and 10% level, respectively.