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# The Origins of Terrorism

## Cross-Country Estimates on Socio-Economic Determinants of Terrorism

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### Abstract:

To expand our knowledge about an appropriate anti-terror strategy, it is indispensable to assess the underlying causes of terror. We examine social and economic conditions in the country of origin of terrorist attacks, claiming that low opportunity costs of terror, e.g. approximated as slow growth and poor institutions raise the propensity of terror and the willingness in the population to support terror. Using a mixed effects Poisson regression model, we are able to show that unfortunate socio-economic conditions in a country are suitable to reduce the opportunity cost for potential terrorists and increase the likelihood of terrorist attacks originating from a specific country. Interestingly, this effect is relevant after a certain level of development has been reached. We therefore distinguish between the OECD, Europe and Islamic countries.

JEL classification: P16, F15, C25

Keywords: terror attacks, openness, discrete choice analysis, institutions

## 1. Introduction

Still, the prevailing strategy to reduce terrorism, or, more dramatic, *the war on terrorism* is characterized by the attempt to isolate the terrorists and their supporters. This strategy is successful in that it helps reducing immediate terror threats, but also has cost in fiscal terms as well as with respect to declining civil liberties (The Economist 2008). In the economic literature, this approach is implicitly backed by a number of empirical analyses (e.g. Abadie 2006, Krueger and Laitin 2008, Krueger and Malecková 2003, Kurrild-Klitgaard, Justensen and Klemmensen 2006) which show the high education and good economic status of terrorists. The authors of these studies argue that the determinants of terror are of political nature: repression, low economic freedom and restricted civil liberties. We argue that this view is too simplistic as it misses some decisive aspects of terror and its foundations. In particular, it seems necessary to consider the environment of terrorist and their economic, social and political circumstances. In order to develop their strategies, terrorists need retreats and backing in the population. This backing may depend on a set of variables documenting the very economic, social and political aspects. Given the widespread underdevelopment of Middle East countries as well as many other countries where terror is originating from, hawkish counterterrorist strategy may prove backfiring. For the development of sustainable anti-terror strategies, a deeper knowledge of the origins and causes of terrorism is required. In this study, we want to contribute some results that may be a part of such a foundation.

Specifically, our study contains a first systematic analysis of the origins of terrorism by analyzing the economic, political and social background of terrorists and subsequently investigating some of the implications empirically. Thereby, we do not scrutinize individuals, but rather special emphasis is devoted to the economic and political situation in those countries from which terrorists originate. The focus is laid upon active terrorists and their background rather than on terrorist leaders, as the latter regularly use terror as a means to meet other objectives. The main hypothesis is that terror can originate more easily in countries, regions or cities where poor economic conditions and political institutions prevail. Here, the difficulty, of course, is to find reliable data about the origins of terrorism. One difficulty surely is that terrorists – including suicide bombers – often cannot be recognized after their attack. Nevertheless, it is worthwhile to conduct this study, given the enormous importance to learn about the motivation of terrorists and their environment against the background of the need for effective and efficient anti-terror strategies, even if one has to be

particularly cautious in interpreting of the results. As our main results, we challenge the widespread believe that poverty and economic conditions are not determinants of terror. Opportunity costs of all stakeholders do not only depend on political variables.

The remainder of the paper is organized as follows. After a theoretical analysis of terrorists' behavior in Section 3, we provide empirical evidence on its driving forces in Section 4. For our empirical estimates, we apply a mixed effects Poisson regression model to take into account the special nature of our explanatory variable. The core parts of the paper are surrounded by the following Section 2 which is dedicated to an overview about the related literature, and the conclusions in Section 5.

## 2. Related Literature

The economic literature on terrorism has increased remarkably in recent years. Terrorism can be analyzed from different perspectives. First, a number of contributions deal theoretically with terrorism, investigating its causes and circumstances from aggregate and individual perspectives. Second, a bulk of studies empirically analyze the determinants of the genesis and attack patterns of transnational as well as on domestic terrorism.<sup>1</sup> Third, other analyses try to evaluate the economic or political costs of terror. Fourth, some contributions provide policy recommendations to reduce terrorism threats. In our paper, we add to the theoretical and empirical literature on terrorism determinants. In the next section of this contribution, we provide some theoretical reasoning that emphasizes the role of opportunity costs in explaining terrorists' behaviour. Later, we also provide an empirical check of our theory, trying to explain potential causes for terror originating from a country.

A common definition characterizes terrorism is the “premeditated use, or threat of use, of extreme violence to obtain a political objective through intimidation or fear directed at a large audience.” (Tavares 2004, p.1041). Economic theory on terrorism assumes that terrorists are rational individuals. Caplan (2006) discusses rationality in the context of terror in-depth. Cost-benefit – and opportunity cost – considerations associated with rational behavior are applied to terrorist activities. Terrorists ultimately want to achieve a redistribution of power

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<sup>1</sup> *Transnational Terrorism* means terrorism involving citizens, groups or the territory of more than one country. *Domestic terrorism* means terrorism involving only citizens, groups or the territory of one country. See Enders and Sandler (2006) for a further discussion.

and wealth which is not enforceable in the ordinary political process (Frey and Luechinger 2003). Terror is chosen as a means to meet these objectives (Harrison 2006). In the short run, terrorism aims at destabilizing the economy and polity of affected countries, and at gaining publicity (Tavares 2004). In the long run, terrorists want to enforce their ultimate goals. Consequently, benefits from terror arise when terrorists are successful in approaching short-run or long-run goals. Costs from terror result e.g. from the exhaustion of resources or the possibility of governmental punishment. As long as terrorists' marginal benefits exceed marginal costs, terror is chosen as a tool to reach political objectives (Frey and Luechinger 2004). Sandler and Enders (2004) provide an overview of diverse economic modeling approaches – for instance, game theory or utility-maximizing models – that have been applied to analyze terrorism from an economic point of view.

However, killing other people arbitrarily to meet political objectives requires strong emotions; it may need more than a simple assessment of costs and benefits. Victoroff (2005) sums up psychological approaches to terrorist activity, finding that 'typical' terrorists are characterized by, *inter alia*, strongly perceived feelings of oppression or humiliation and by a drive for expression, vengeance or identity. That is, individual traits and feelings may make the decision to become a terrorist and to conduct terrorist actions more attractive. The interactions of terrorists and their leaders – and other group dynamics – may also shape terrorist behavior (Victoroff 2005). Glaeser (2005) analyzes the importance of hatred as one fundamental incentive to become a terrorist. In his model, hatred is supplied by political competition, where demand depends negatively on citizens' contact to foreigners and minorities. Wintrobe (2003) develops a model where individual terrorists choose between two goods, namely intellectual independence and group solidarity. The potential terrorist trades independence against solidarity – and identity, as Harrison (2006) stresses – as well as strong leadership. Wintrobe's model shows that terrorist activity may depend on individual desires and emotions. In his model, the demand for solidarity makes terrorism – including suicide terrorism<sup>2</sup> – rational. That is, this theoretical approach implicitly argues with the opportunity costs of terrorism.

The environment of terrorists – e.g. families and other terror supporters – also influences the behavior of terrorists. For instance, parents may support the decision of their children to

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<sup>2</sup> Due to its nature, the logic and rationality of suicide terrorism has gained particular attention in academic discourse. See e.g. Pape (2003), Azam (2005), Caplan (2006) and Harrison (2006) for further discussions.

become (suicide) terrorists, if the children's future is unpromising and if – as an alternative to non-violence – the children's actions as a terrorist guarantee martyr's status in the society or financial support from terrorist organizations. Similarly, Harrison (2006) argues that the terrorists' environment also takes into account the opportunity costs of violence. For instance, terrorist supporters weigh off the identity created by terrorism against the benefits from non-support, basing their actual decision on the opportunity costs of terror.

On the one hand, individual traits, group dynamics and the environment of terrorists contribute to an explanation of terrorism, as they are linked to the concept of the opportunity costs of terror. On the other hand, terrorists and their supporters are also influenced by country-specific factors which provide incentives or disincentives for violence – or for the support of terror – as they reflect the cost-benefit considerations of terrorists and their environments. Some scholars have linked economic factors to terrorist activity (e.g. Gurr 1970). For instance, in times of recession the opportunity costs of violence are relatively low, causing an increase in violent behavior (e.g. Blomberg, Hess and Weerapana 2004). Similarly, economic integration may curtail economic opportunities of globalization 'losers', reducing their opportunity costs of violence and thus potentially triggering terror risks. Other scholars have hinted at the role of the political and institutional order (e.g. Kirk 1983; Ross 1993) or the socio-demographic position (e.g. Ross 1993; Ehrlich and Liu 2002) of countries affected by terrorism. Others have stressed the role of identity conflicts (e.g. Huntington 1996) or of political instability and state failure (e.g. Patrick 2006) in contributing to the genesis of terrorism. All of these approaches argue that the surroundings of terrorists and their supporters influence their cost-benefit considerations in ways that significantly sway violent behavior. Thus, the level of terrorist activities in certain countries depends on the match of individual traits of terrorists, group dynamics, on the environments of terrorists and on country-specific circumstances that affect individuals, all of which impact the opportunity costs of becoming – or supporting – a terrorist and acting violently. For our empirical analysis, we focus on country characteristics and their effect on terror opportunity costs.

A bulk of empirical analysis tries to unveil the determinants of terrorism, using aggregate data. Most empirical literature employs large country samples with long-time horizons. These studies mostly focus on transnational terrorism, recognizing its dyadic nature with respect to

the sources and targets of transnational terrorism.<sup>3</sup> Some analyses only center on country- or region-specific terrorism determinants to detect country- or region-dependent terrorism dynamics.<sup>4</sup> Our empirical analysis in this contribution assesses the origins of terrorism, adopting a global as well as region-specific perspective on terrorism dynamics.

Analyzing the sources of transnational terrorism means to investigate the circumstances from which terrorists originate, regardless of their eventual targets. The empirical literature assesses the relevance of economic, political and institutional, socio-demographic and other factors to explain the production of terrorism (Krieger and Meierrieks 2008). Existing evidence is mixed on the impact of economic factors in terrorism. While Lai (2007) and Blomberg and Hess (2008) find that structural economic conditions – e.g. high income and income equality – discourage terrorism, Krueger and Malečková (2003) and Kurrild-Klitgaard, Justensen and Klemmensen (2006) do not find significant connections between long-run economic conditions, short-run economic performance and terrorism. Interestingly, both Blomberg and Hess (2008) and Kurrild-Klitgaard, Justensen and Klemmensen (2006) find a negative correlation between trade openness and terrorism production. This suggests that economic integration is not – as argued by Wintrobe (2006) – recognized as a threat but rather as an opportunity for economic gains. Further studies put an emphasis on political and institutional factors, arguing that their importance trumps economic ones. Basuchoudhary and Shughart (2007) detect a negative link between the quality of economic institutions and the generation of terrorism, suggesting a trade-off between institutional opportunities and political violence. In Piazza (2008b), political instability and state failure prominently drive terrorism, e.g. as terrorist organizations capitalize on political vacuums. Kurrild-Klitgaard, Justensen and Klemmensen (2006) also emphasize the primacy of political factors in contributing to terrorism production. Burgoon (2006) highlights the role of social welfare policies in scaling down terrorism production, e.g. by decreasing economic inequalities or restricting extremist influence in societies. Considering socio-demographic factors, a number of studies find a positive and significant connection between population size and transnational terrorism,

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<sup>3</sup> Although domestic terrorism is a more common phenomenon (Abadie 2006; Enders and Sandler 2006), analyses focus on the determining factors of transnational terrorism due to data constraints. For a comprehensive review of empirical literature on the determinants of terrorism, see Krieger and Meierrieks (2008).

<sup>4</sup> Further studies provide micro evidence on the issue of terrorism that complements other analyses that rely on aggregates. Here, we refer to analyses of Krueger and Malečková (2003) or Krueger (2008). These studies show that on individual levels, high income or high levels of education do not deter individuals from becoming terrorists. Rather, more educated individuals are more likely to become terrorists. See also Benmelech and Berrebi (2007) for a further illustration of this point. Thus, these studies appear to reject some straightforward notions of opportunity costs influencing terrorist behavior.

indicating that demographic stress is associated with increased risks of terrorism (e.g. Burgoon 2006; Lai 2007; Piazza 2008b). For education, Krueger and Malečková (2003) and Kurrild-Klitgaard, Justensen and Klemmensen (2006) do not detect evidence of strong links with terrorism formation. Lastly, several studies also center on the contribution of other factors on transnational terrorism. Azam and Delacroix (2006) show that the receipt of foreign aid reduces transnational terrorism originating from a country. Lai (2007) emphasizes the importance of spatial proximity causing terrorism production, arguing that terrorism ‘infects’ nearby regions as terrorists capitalize on network effects.<sup>5</sup> In general, evidence on the origins of transnational terrorism suggest that economic factors – in particular, trade – as well as political, socio-demographic and other factors may matter for terror production as they affect the cost-benefit – and opportunity cost – considerations of terrorists through various channels.

Investigating the targets of transnational terrorism means to scrutinize the traits of countries targeted by terror, irrespective of the origin of transnational terrorists. Again, research focuses on determinants from the realms mentioned above. Evidence is mixed for the importance of economic factors. On the one hand, Blomberg, Hess and Weerapana (2004), Tavares (2004) and Krueger and Laitin (2008) find that economically successful countries are likelier targets of terrorism, and Piazza (2006) finds no strong link between poverty and terrorism. On the other hand, while Kurrild-Klitgaard, Justensen and Klemmensen (2006) emphasize the importance of trade openness in deterring terrorism, Li and Schaub (2004) as well as Drakos and Gofas (2006) come to different results, arguing that economic integration is not directly linked to terrorism or that, respectively, low trade openness attracts attacks. A number of studies also stress the importance of political factors such as liberal political institutions (e.g. Li 2005) in discouraging terrorist attacks, arguing that the effects of politics outweighs the ones of economics (e.g. Piazza 2006; Krueger and Laitin 2008).<sup>6</sup> As with the origins of transnational terrorism, attacks are also positively associated with population size and other factors that represent socio-demographic stress (e.g. Li 2005; Drakos and Gofas 2006). International politics may also matter: Dreher and Gassebner (2008) show that political proximity to the United States increases the likelihood of being attacked by transnational

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<sup>5</sup> Similarly, Enders and Sandler (2006) provide time-series evidence hinting at temporal contagion effects of terrorism. Here, existing terrorist regimes determine the frequency and intensity of future attacks, suggesting a path dependence of terrorism.

<sup>6</sup> While Abadie (2006) does not distinguish between the origins and targets of transnational terrorism but employs a general index of terrorism risk in his analysis, his findings nevertheless hint at potential effects of political factors. He finds a non-monotonic relationship between terrorism and political rights, suggesting that countries undergoing political transformation are especially prone to terrorism.



terror. Overall, evidence indicates that a variety of factors may influence the decision of terrorists to attack. Apparently, cost-benefit considerations play a vital role. For example, attacking richer rather than poorer countries should generate higher payoffs, thus inducing accordant terrorist attack patterns.

Considering the Middle East – that is, Islamic countries – as a region highly affected by terrorism, the studies by Testas (2004) and Piazza (2007) offer region-specific evidence. Testas (2004) find that political factors – liberal institutions and civil war – are more important than income for explaining terrorist attacks. Piazza (2007) employs both a target and source approach to terror. He finds that state failure produces terror and attracts attacks, while the economy again does not matter strongly. Still, both studies do not fully take into account regional institutions. Kuran (2004) emphasizes that specific regional institutions prevented the emergence of business enterprises for a long time. Instead, institutions were implemented that only ineffectively replace business enterprises. The Islamic law of inheritance inhibited capital accumulation, while the lack of stock markets prevented the possibility of diversification and easy transfer of equity.<sup>7</sup> As a result, the emergence of large corporations exploiting scale and scope economies that were central for the development of European capitalist societies (Chandler 1990) has almost been prevented. Disregard of property rights, arbitrary taxation and corruption also contributed to low levels of economic development in the region (Kuran 2004), where these institutional arrangements have been consistently found to be detrimental to economic growth (e.g. Barro 1997; Knack and Keefer 1995; Mauro 1995). Testas (2004) and Piazza (2007) do not focus on economy-related institutions and their impact on terrorism. In our empirical analysis, we focus on this issue, providing specific evidence for Islamic countries. As we argue that the terrorists' calculus is driven by the opportunity costs of terror, we expect a noticeable effect of poor institutions on terrorism production in Islamic countries.

Terrorism produces enormous costs which a number of empirical studies try to assess. First, terrorism produces costs directly linked to terrorist actions, e.g. human casualties or material damages. Second, there are indirect costs related to the economic or political realm. These costs correspond to the short-run goals of terrorism, i.e. to a destabilization of attacked economies and polities.

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<sup>7</sup> This does not necessarily imply that business enterprises are incompatible with Islam, but that they did not emerge under the rule of Islamic law.

Nitsch and Schumacher (2004) and Blomberg and Hess (2006) suggest that terrorism negatively affects trade between countries, acting as a form of additional tax on trade. The results by Enders and Sandler (1996) and Enders, Sachsida and Sandler (2006) similarly suggest that terrorism distorts FDI flows. Terrorism may also harm tourism in affected countries (e.g. Enders and Sandler 1991; Enders, Sandler and Parise 1992; Drakos and Kutan 2003). Its negative impact on certain industries is also documented. For instance, Berrebi and Klor (2005) show that terrorism in Israel negatively affect non-defense industries, while shifting resources into the defense and security sector of the economy. Given the negative effects of terrorism on resource flows and allocation as well as on specific sectors of an economy, it is not surprising that a number of studies detect a negative and significant effect of terror on overall economic growth (e.g. Abadie and Gardeazabal 2003; Eckstein and Tsiddon 2004; Crain and Crain 2006; Gaibulloev and Sandler 2008). Finally, as shown by Gupta et al. (2004), terrorism may boil down to fiscal and macroeconomic burdens. Through conflict, inter alia, budget deficits are generated, causing higher inflation, less macroeconomic stability and thus less future growth. Evidence therefore confirms that terrorists are successful in their efforts to damage the economies they attack.

Terrorism also leads to political costs. Gassebner, Jong-A-Pin and Mierau (2008) show that terrorist attacks increase the probability of government replacement, thus potentially contributing to political instability. Indridason (2008) and Berrebi and Klor (2008) also demonstrate effects of terrorism on coalition formation or voting behavior in affected countries, so terrorism influences internal politics. Dreher, Gassebner and Siemers (2007) show that terror makes it more likely that the governments of targeted countries lose respect for human rights, potentially curtailing civil liberties in consequence. Empirical analyses thus suggest that terror affects targeted polities. As domestic politics are substantially manipulated, terrorists seem to be generally effective in achieving political destabilization.<sup>8</sup>

Contributions dealing with the remedies of terror basically advocate two strategies: the hard and the soft one, or, as Frey (2004) puts it, “stick and carrot”. Counterterrorism may aim at

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<sup>8</sup> Considering the costs of terrorism from an economic or political cost side may not provide a complete picture. Frey, Luechinger and Stutzer (2007) propose to calculate the costs of terror from a life satisfaction perspective. They argue that individual losses in life satisfaction surmount the economic costs of terrorism. In Frey, Luechinger and Stutzer (2004), they show that terrorist attacks decrease life satisfaction to a large extent. That is, not only from economic or political but also more holistic social perspectives, terrorists seem to succeed in damaging the societies they attack.

raising the material costs of terrorism, e.g. by means of retaliation, tightened security or no-negotiation, thereby generating payoffs for governments under certain circumstances when optimal levels of terrorism shift to less violent levels (e.g. Lapan and Sandler 1988). Sandler (2003) argues that transnational terrorism can only be combated by means of deterrence through collective actions. Inter alia, Frey and Luechinger (2003, 2004) and Frey (2004) have criticized deterrence strategies due to its costs, e.g. by producing feedbacks. For instance, Fratianni and Kang (2005) use a gravity model to show that increasing border security is likely to decrease trade between the country of origin and the target country of terrorism, probably reducing economic welfare in the country of origin and further raising sentiments against the potential target of terror. Following our theoretical reasoning below, this in turn diminishes opportunity costs of potential terrorists. Hawkish and repressive political reactions in the target countries may thus be a further incentive to increase terrorist activities, e.g. as such policies increase the marginal benefits of terror.

Frey and Luechinger (2003) and Frey (2004) instead argue that it is more fitting to center on the “carrot” when fighting terror by raising the opportunity costs of terrorists, e.g. by offering them the possibility of economic or political participation. For our theoretical and empirical approach, we also connect terrorism to its opportunity costs. The idea of our empirical analysis is to identify those factors that impact the opportunity costs of terrorists in ways that reduce violent behavior, thereby becoming “carrots” in the hands of policymakers.

### **3. Theoretical Motivation: Opportunity Costs of Terror**

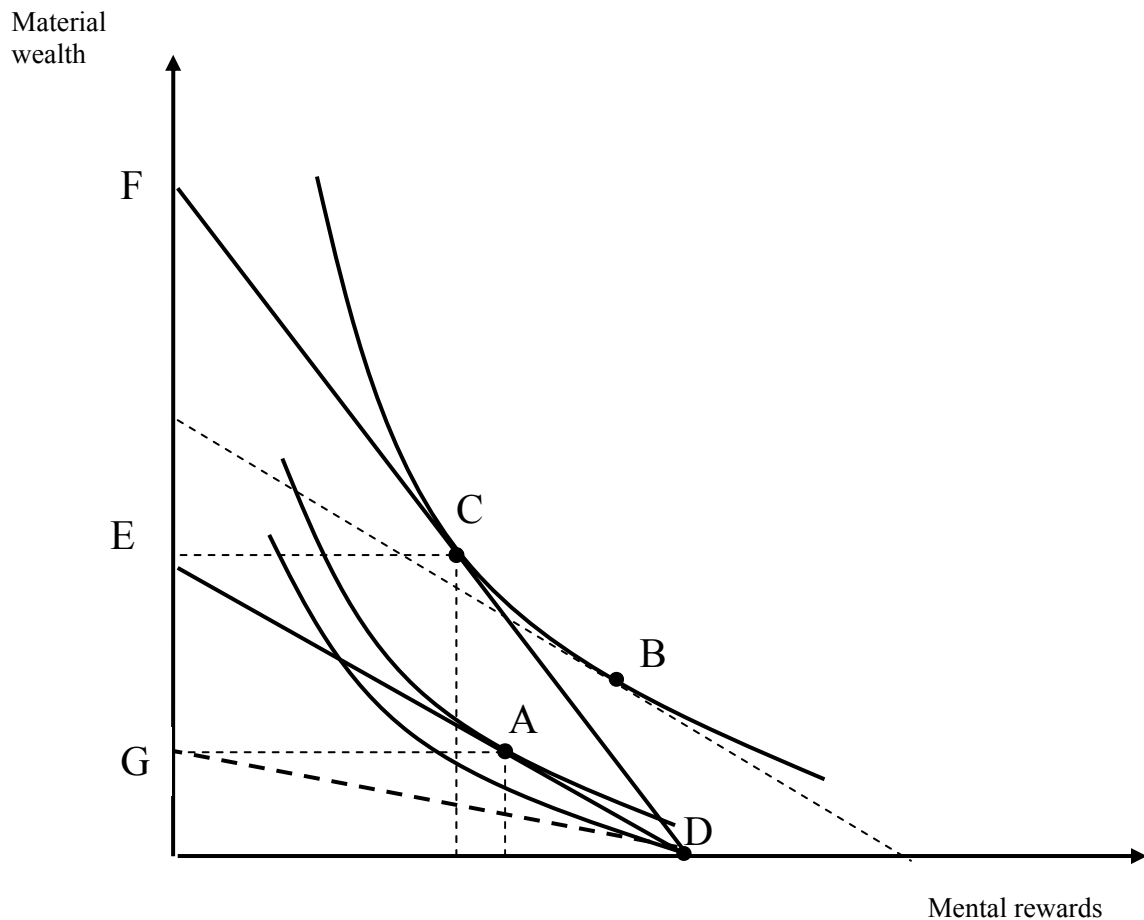
The enormous costs of terrorism justify an analysis of the motivation of – potential and current – terrorist. In this paper, we contribute to this literature by reasoning theoretically about the causes of terror in a simple microeconomic framework. In a nutshell, opportunity costs drive the decision to act as a terrorist. However, the concept of opportunity costs should be applied differently to different subgroups, of which we distinguish three: leaders, terrorists and their environment. First, terrorist leaders who organize terror are to be considered. For them, personal opportunity cost may not be directly measurable. Nevertheless, they may follow an economic reasoning by selecting the adequate strategy to pursue their goals. Obviously, they cannot meet their objectives without violence, which is a means rather than an end. Their opportunity costs are reflected in this difficulty. Terrorist leaders obviously

need to recruit troops. The incentives of these recruited persons – and their environment – are different in comparison to the ones of their leaders. In order for a terrorist group to survive, these individuals are often more relevant than the leaders.

Thus, in what follows we concentrate on active terrorists who commit the acts and their environment, which may offer a retreat and other forms of mental and physical support. The predisposition of an individual to become or support a terrorist is assumed to depend on the opportunity costs of terror. These in turn depend on the social and economic situation in the individual's home country. This does not rule out that individual terrorists are well educated and wealthy. We do not concentrate on individual characteristics of single terrorists. Our theoretical model is based on Wintrobe's (2003) idea of analyzing the trade-off between independence and solidarity. Solidarity includes the support of the environment. Within this framework, the opportunity costs of terrorism can be illustrated quite easily. The two goods we consider are individual wealth on earth and mental rewards for the terrorist. The terrorist is assumed to perceive life on earth as less useful than the mental rewards, support and group solidarity, even including the promise to move into paradise after a successful suicide strike.

We distinguish between two choices, namely the decision to become a terrorist or not, i.e. to consume mental rewards or goods and services on earth. Analogous to the analysis of income and substitution effects in microeconomics, this decision can be analyzed in terms of the different utilities derived from either living in peace – and making a living on earth – or engaging in activities that lead to a terror assault, thereby qualifying for mental rewards. In Figure 1, consider an original budget constraint, represented by the line DE, together with some indifference curves. The individual's utility is maximized in A. If life on earth becomes more attractive, e.g. as per capita GDP increases, civil liberties increase and the like, the budget constraint moves to DF. In the case of given preferences, utility is maximized now in C, with B showing the income effect. The individual prefers more consumption and fewer activities related to terror. The opportunity costs of terrorist activities have risen. If, however, the opportunity costs decrease by a sufficiently large degree, e.g. because the state gets more repressive, so the budget constraint moves to DG, and terror is becoming increasingly attractive. In an extreme case, a corner solution is reached and utility is maximized in D. In this case, the individual chooses to commit a suicide bombing.

Figure 1  
Choice between the Consumption of Goods and Mental Rewards



We argue that we can apply the theoretical thoughts both to the active terrorist and to his environment. Although the latter does not commit the terrorist acts, the propensity of individuals to be sympathetic to terrorists is a function of the opportunity costs. The better conditions today and prospects for the future, the less understanding these individuals have for terrorists – they simply have more to lose.<sup>9</sup> In other words, an outward shift of the budget constraint in Figure 1 reduces the public support for terror and thereby indirectly actual terrorist activities. For instance, parents are less willing to send their kids to death; the opposite holds if the budget constraint moves to DG. The opportunity costs determine the quality of a country, region, city or suburb as a breeding ground for terrorism.

<sup>9</sup> One may argue that the declining violence in Northern Ireland or in the Basque country is supporting this line of reasoning. Similarly, the declining success of the RAF in Germany shows this pattern.

Therefore, the basic hypothesis is that terror is rooted in regions or countries in which the opportunity costs of terrorism are low. Thus, it is not the individual terrorist whose characteristics are important as the individual often may be mentally ill and disguised. Rather, the atmosphere of the environment of terrorists and their background matter.

#### 4. Data and Results

Unfortunately, the individual decision to become a terrorist and its dependence on socio-economic characteristics in the country of origin are not observable to us. What we can observe, however, are country aggregates with respect to terrorist activities. This implies that our dependent variable is a count magnitude (non-negative integers), namely the numbers of attacks made by individuals originating from a certain country during a given time span. This requires the application of regression methods specifically designed to cope with count data. Moreover, the data we have available allow us to implement the regressions in a panel context. Therefore, we use a mixed effects Poisson regression model to explain the number of terrorist attacks by a set of country characteristics intended to approximate opportunity costs. These variables comprise of three groups, namely macro variables, properties of the population and institutional indicators.

The data for the number of terror assaults during 1971 to 2005 originating from a country are from the Terrorist Knowledge Base of the MIPT (2006), a US governmental funded think tank. From these data a variable  $Y_{it}$  is constructed, representing the number of terror incidents originating from a country  $i$  during a five year span  $t$  (1971-1975, ..., 2001-2005). We have five different samples: all countries available, OECD countries (OECD), European countries (Europe), Islamic countries (Islam), and Islamic countries excluding oil producers (Islam2).<sup>10</sup>

Opportunity costs of terror are expressed by a number of variables, collected in the vector  $\mathbf{x}_i$ . To start with macro variables as a first group, openness to foreign trade can have positive or negative effects on the propensity to terror. If trade is low, increasing openness is assumed to be beneficial for individuals and, therefore, may be negatively related to terror. With increasing trade, the threats from trade for some individuals become obvious; trade then may be positively related to terror. Thus, we expect that openness in the OECD and Europe is

positively, in Islamic countries negatively correlated with terror. With respect to wealth, we expect increasing opportunity costs – and less terror – with higher GDP per capita and GDP growth. Another proxy for opportunity costs is investment: the higher investment, the lower the willingness of individuals to become terrorists. A high share of government consumption in GDP can again be interpreted in two ways: on the one hand it can be expressed as a proxy for misallocation, as the government demands a huge share of incomes – and uses it – for consumption purposes. Thus, it reduces opportunity costs of terror. On the other hand, it can be an input – education, health, infrastructure, social welfare policies (e.g. Burgoon 2006) – for economic improvement and therefore increase opportunity costs.

The second group of variables controls for some properties of the citizens. Higher education – or human capital – should increase opportunity costs of terror.<sup>11</sup> The opposite can be expected if the size of population in absolute number is high. The indicator characterizing the population is the size of population.<sup>12</sup>

Third, some variables can give information about opportunity costs of terror resulting from other country-specific effects. The opportunity costs are higher, the lower the institutional quality in a country is, measured by the Fraser Index for Economic freedom (Gwartney et al. 2007). One would expect that this relation is stronger in countries with less economic freedom than in countries with more economic freedom, as smaller differences on a high level are less relevant. In addition, the number of patents granted in the US originating from a country is expected to be negatively related to terrorism, as this number shows the technological strength of the country. The higher the number of patents is, the higher are the opportunity the costs of terror. However, it again can be interpreted differently for different country groups. If there is no technological base, this variable may be less relevant than for countries with a broader base.

The data for the explanatory variables are assembled from various data sets that are frequently used in the literature on cross-country growth regressions. These consist of updates of the Penn World Table (PWT 6.1), with an earlier version being described in Summers and Heston

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<sup>10</sup> See Tables 2 to 4.

<sup>11</sup> We opt for this clear-cut hypothesis, although we acknowledge that higher levels of education have sometimes also been argued to be positively linked to terrorism production in parts of the literature (e.g. Krueger and Malečková 2003).

<sup>12</sup> It would be superior to use the share of young persons – under 15 years of age – adding to potential violence (e.g. Ehrlich and Liu 2002; Heinson 2003). However, data are not available.

(1991) and various other sources. In particular, the explanatory variables used in the regressions are:

- openness to international trade (squared) is from the PWT 6.1 (exports plus imports divided by GDP, constant prices, in percent);
- material wealth in the economy is quantified by the variable real GDP per capita from the PWT 6.1 (real GDP per capita, constant prices, chain index);
- alternatively, we use the growth rate of real GDP per capita;
- capital accumulation in the economy is from the PWT 6.1 (investment share of GDP, constant prices, in percent);
- consumptive governmental expenditures in the economy is quantified by the variable KG from the PWT 6.1 (government share of GDP, constant prices, in percent);
- human capital is measured by the average schooling years in the total population older than 15 years, taken from an updated version of the data set of Barro and Lee (1993, 1996);
- population is quantified by the variable POP from the PWT 6.1 (population in 1000);
- patents, denoted as the number of patents granted in the USA during 1980 to 1990 using data from the US Patent and Trademark Office (USPTO). The number of patents is transformed by the natural logarithm to limit the differences between countries with a relatively low number of patents and countries with a relatively high number of patents. The case of countries with a zero number of patents is allowed for by the addition of unity;
- the quality of institutions in a country is quantified by the index of Economic Freedom from Fraser Institute (Gwartney et al. 2007).

Table 1 displays the descriptive statistics.



Table 1  
Descriptive Statistics

	full sample	OECD	Europe	Islam	Islam2
no. of terror incidents	9.52	9.08	10.46	6.77	7.95
lagged terror dummy	0.31	0.40	0.38	0.38	0.42
openness	61.73	47.18	55.32	69.08	61.06
real GDP per capita	8365.68	15518.78	16895.01	4913.00	2567.83
real GDP p.c. growth rate	0.09	0.13	0.13	0.06	0.08
investment ratio	17.12	22.87	23.54	13.34	11.79
government ratio	20.08	17.57	18.35	23.37	22.71
human capital	5.72	8.22	7.88	3.39	3.13
population	42897.63	34682.30	17986.15	38466.55	42746.85
Fraser index	5.67	6.42	6.53	5.07	4.90
no. of patents	944.71	2986.86	638.62	0.96	0.88
no. of countries	95	26	16	16	13

Note: the figures are sample means over all 5-year periods considered; this also applied to the GDP growth rate which actually is the average of the growth rates over subsequent 5-year spans.

As noted earlier, we apply a mixed effects Poisson regression model with the following properties. This mixed effects Poisson regression model is a simple and robust variant of a panel model for count data. Compared to alternative methods it is not able to account for overdispersion but it is also less affected by convergence problems in the numerical optimization needed to compute the estimator and it is also less affected by the problem of multiple optima (a problem which is completely absent in the Poisson model for cross-section data).<sup>13</sup>

Let  $Y_{it}$  denote the number of events occurring during a fixed period of time with  $i \in \{1, \dots, N\}$  indicating countries and  $t \in \{1, \dots, T_i\}$  indicating the five-year periods we use. Realized for country  $i$  at time  $t$  is  $y_{it} \in \{0, 1, 2, \dots\}$ , i.e. a non-negative integer, the number of terror incidents in our case.

The stochastic component of the model is specified by a Poisson distribution with parameter  $\lambda_{it}$ , i.e.  $Y_{it}$  is distributed as  $\text{Poisson}(y_{it} | \lambda_{it}) = \exp(-\lambda_{it}) \cdot \lambda_{it}^{y_{it}} / y_{it}!$ , where the systematic component is  $\lambda_{it} = \exp(\mathbf{x}'_{it}\boldsymbol{\beta} + b_i)$  with  $\mathbf{x}_{it}$  denoting the vector of explanatory variables and  $\boldsymbol{\beta}$

<sup>13</sup> See Cameron and Trivedi (1998) for an account of count data regression. All estimates reported in this paper are computed using the function “poisson.mixed” of the Zelig package for R (Bailey and Alimadhi 2007).

the vector of regression parameters. Finally,  $b_i$  is an individual specific random effect which is distributed as normal with zero mean and constant variance.

We run three specifications of the model for all five country groups. The first specification (Table 2) uses the log level of real GDP per capita as one central explanatory macro variable, the second specification (Table 3) is built upon the quadratic effect of log GDP per capita, whereas the third specification (Table 4) uses the growth rate of real GDP per capita.

Table 2  
Mixed Effects Poisson Estimates  
(Specification with Level of Real GDP per Capita)

	full sample	OECD	Europe	Islam	Islam2
intercept	-35.387 (-27.340)	-15.164 (-5.364)	-18.725 (-5.469)	-15.988 (-4.418)	-17.368 (-3.877)
lagged terror dummy	1.321*** (21.006)	0.749*** (6.018)	0.458*** (2.764)	1.908*** (10.631)	2.470*** (10.438)
log(openness)	1.404*** (16.799)	1.294*** (8.408)	2.257*** (9.816)	-0.354 (-1.550)	-0.488** (-2.004)
log(real GDP per capita)	2.318*** (16.400)	0.662** (2.158)	-0.354 (-0.882)	0.766** (2.406)	1.347*** (2.921)
log(investment ratio)	-1.198*** (-11.176)	-0.657*** (-3.673)	0.234 (0.688)	0.420* (1.696)	0.630** (2.260)
log(government ratio)	0.094 (0.936)	-0.833*** (-3.095)	-1.907*** (-5.987)	-0.091 (-0.245)	-0.241 (-0.579)
log(human capital)	-1.523*** (-9.772)	-0.898** (-2.449)	1.735*** (3.102)	0.836** (2.242)	0.792 (1.587)
log(population)	1.592*** (25.362)	1.133*** (9.918)	2.483*** (12.668)	0.761*** (5.532)	0.539*** (3.419)
log(Fraser index)	-0.288* (-1.797)	0.635 (1.495)	-1.699*** (-3.143)	0.798* (1.839)	0.334 (0.650)
log(1+patents)	0.068* (1.710)	-0.280*** (-4.138)	-0.897*** (-9.612)	0.449*** (3.157)	0.556*** (3.697)
pseudo- $R^2$	0.125	0.412	0.372	0.279	0.289
$LRI$	0.709	0.513	0.580	0.878	0.859
$n$	574	177	112	96	79

Note:  $t$ -statistics in parentheses. Goodness-of-fit measures: pseudo- $R^2$  denotes an  $R^2$ -type measure computed as the squared correlation coefficient of the realized and fitted values of the dependent variable;  $LRI$  denotes the likelihood ratio index which is simply Mc-Fadden's- $R^2$ . \*\*\*, \*\* and \* denote significance at 1%, 5% and 10% levels, respectively.

Table 3  
Mixed Effects Poisson Estimates  
(Specification with Quadratic Effect of Real GDP per Capita)

	full sample	OECD	Europe	Islam	Islam2
intercept	-79.367 (-21.695)	-89.727 (-5.291)	-386.170 (-7.505)	-92.742 (-5.215)	-62.047 (-2.106)
lagged terror dummy	1.551*** (24.922)	0.617*** (4.842)	0.133 (0.780)	1.621*** (8.607)	2.324*** (9.152)
log(openness)	1.358*** (20.117)	1.395*** (8.944)	2.163*** (8.738)	-0.165 (-0.646)	-0.227 (-0.788)
log(real gdp per capita)	13.317*** (16.135)	17.092*** (4.635)	77.068*** (7.155)	19.698*** (4.587)	12.377* (1.727)
log(real gdp per capita) squared	-0.646*** (-13.894)	-0.858*** (-4.483)	-3.991*** (-7.203)	-1.127*** (-4.374)	-0.690 (-1.544)
log(investment ratio)	-1.139*** (-12.640)	-1.280*** (-5.625)	-0.148 (-0.424)	0.324 (1.264)	0.586** (2.028)
log(government ratio)	0.095 (1.085)	-1.211*** (-4.273)	-2.382*** (-7.114)	-0.299 (-0.762)	-0.293 (-0.659)
log(human capital)	-1.478*** (-11.010)	-1.761*** (-4.178)	-0.439 (-0.659)	0.546 (1.469)	0.935* (1.820)
log(population)	1.278*** (30.841)	1.117*** (9.715)	2.191*** (10.454)	0.595*** (3.817)	0.572*** (3.266)
log(Fraser index)	0.402*** (2.728)	0.866** (2.014)	-0.562 (-0.965)	0.869* (1.872)	0.023 (0.043)
log(1+patents)	-0.028 (-0.877)	-0.220*** (-3.179)	-0.828*** (-8.306)	0.505*** (3.355)	0.615*** (3.881)
pseudo- $R^2$	0.113	0.403	0.422	0.247	0.263
$LRI$	0.662	0.523	0.626	0.887	0.863
$n$	574	177	112	96	79

Note:  $t$ -statistics in parentheses. Goodness-of-fit measures: pseudo- $R^2$  denotes an  $R^2$ -type measure computed as the squared correlation coefficient of the realized and fitted values of the dependent variable;  $LRI$  denotes the likelihood ratio index which is simply Mc-Fadden's- $R^2$ . \*\*\*, \*\* and \* denote significance at 1%, 5% and 10% levels, respectively.

Table 4  
Mixed Effects Poisson Estimates  
(Specification with Growth of Real GDP per Capita)

	full sample	OECD	Europe	Islam	Islam2
intercept	-17.525 (-28.851)	-9.807 (-7.887)	-20.667 (-8.768)	-7.942 (-5.496)	-5.113 (-2.923)
lagged terror dummy	1.394*** (22.298)	0.801 (6.574)	0.359* (2.184)	1.813 (10.010)	2.451 (10.453)
log(openness)	1.719*** (22.261)	1.434*** (10.139)	2.147*** (10.811)	-0.372 (-1.674)	-0.534** (-2.401)
growth rate of real GDP per capita	-0.857*** (-3.547)	-0.701 (-1.285)	1.205 (1.661)	-1.484*** (-2.757)	-2.354*** (-3.666)
log(investment ratio)	-0.646*** (-6.067)	-0.465* (-1.941)	-0.216 (-0.525)	0.786*** (3.512)	1.333*** (5.166)
log(government ratio)	0.116 (1.182)	-0.942*** (-3.387)	-1.781*** (-5.558)	-0.631* (-1.989)	-1.022*** (-3.022)
log(human capital)	-0.083 (-0.640)	-0.749* (-2.022)	1.962*** (3.399)	1.433*** (5.344)	1.870*** (6.372)
log(population)	1.201*** (21.566)	1.040*** (9.368)	2.520*** (12.732)	0.567*** (5.369)	0.350** (2.664)
log(Fraser index)	-0.369** (-2.266)	0.766* (1.718)	-2.073*** (-3.494)	0.939** (2.083)	0.336 (0.697)
log(1+patents)	0.487*** (17.565)	-0.175*** (-3.513)	-0.939*** (-10.154)	0.609*** (4.364)	0.658*** (4.556)
pseudo- $R^2$	0.137	0.409	0.376	0.286	0.285
LRI	0.686	0.516	0.582	0.879	0.857
$n$	569	177	112	94	77

Note:  $t$ -statistics in parentheses. Goodness-of-fit measures: pseudo- $R^2$  denotes an  $R^2$ -type measure computed as the squared correlation coefficient of the realized and fitted values of the dependent variable;  $LRI$  denotes the likelihood ratio index which is simply Mc-Fadden's- $R^2$ . \*\*\*, \*\* and \* denote significance at 1%, 5% and 10% levels, respectively.

As the tables show, the results are somewhat mixed, but give support to our hypothesis, namely that opportunity costs of terror drive the number of attacks originating from a country, where this number negatively depends on macroeconomic performance, positively depends on population size, and is negatively related to institutional quality. To start with, the lag terror variable suggests path dependence. This path dependence matches with previous findings of temporal contagion effects of terror, e.g. as in Enders and Sandler (2005) or Lai (2007). For instance, longer terrorist campaigns should generate more media attention, thereby making such a strategy more attractive. Terrorist inclination apparently is a long-term phenomenon, which makes it even more necessary to analyze its causes.

To start with the full sample, openness as proxy for the degree of globalization has a positive impact on terror, which implies that in general it is seen as a threat. Considered from the perspective of different country groups, the effect of globalization is as suggested by theory. In rich countries, the threat is bigger than in poorer countries. The impact on terror is positive in Europe and negative in the Islamic world. That is, our findings to some extent confirm earlier results by Blomberg and Hess (2008) and Kurrild-Klitgaard, Justensen and Klemmensen (2006) who also detect a negative correlation between trade openness and terrorism production.

Next, the impact of GDP per capita on terror is significantly positive – except for Europe where it is not significant. When we additionally estimate a variable for the quadratic form in the second specification, the impact of the quadratic term is significantly negative. Higher per capita income has the suggested negative impact on terror. Therefore, the results are only partly contradicting our theoretical reasoning. Similar results pointing at negative effects of higher income on terrorism production are found e.g. in Lai (2007) or Blomberg and Hess (2008). Interestingly, Lai (2007) also documents a positive effect of income on terrorism production in this simple specification, while finding a negative one when using a quadratic specification. He argues that a quadratic term more fittingly displays the production of terrorism in countries that are in intermediate development positions. In such countries, the terror opportunity costs may generally favor its generation. On the one hand, income is not high enough to discourage terror; on the other hand, poor institutions and few available policy resources in such countries may be incapable of solving social conflict. This idea matches with our findings of a threshold effect of development.

The result on income is even less puzzling when looking at growth rates. Real GDP per capita growth is significantly – except for the Islamic countries excluding oil exporters – negative throughout the country groups (see table 3). Obviously, the dynamics of the growth process are more important than its current level. Investment is negatively correlated with terror for the whole sample as well as in OECD countries, including Europe, but positively in the Islamic world. Again, one can argue that a certain level of investment is necessary to increase the opportunity costs of terror. Government expenditures show an insignificantly positive impact for the whole sample. Estimated for OECD and European countries, the impact becomes significantly negative. It is insignificantly so for the Islamic world. These results are somewhat difficult to interpret. In rich countries, government expenditures serve to protect

from all sorts of risk, including the threats of globalization. This corresponds with the findings of Burgoon (2006) on the terror-dampening effect of social welfare policies, as related spending makes up a large part of government expenditure. In Islamic countries, the role of government spending seems to be less pronounced, perhaps because welfare states are less developed in this country group. In sum, governmental expenditures seem to discourage terror only in some world regions.

Human capital discourages terror production significantly in the whole sample and OECD countries. Its influence is not clear in Europe and significantly positive in the Islamic world. Again, the likelihood of education to deter terror is dependent on the educational level. For education, our findings contradict the ones of Krueger and Malečková (2003) and Kurrild-Klitgaard, Justensen and Klemmensen (2006) who do not attribute a strong role to education in reducing the generation of terror. From our findings, human capital encourages terrorism in the Islamic World. Testas (2004) finds that Muslim countries with more educated populations are also likelier targets of terrorism, indicating that an identity between the impact of education on the targets and sources of terrorism exists for these countries. Population pressure appears to increase the propensity of terror significantly. Our findings on population size fit with the general consensus that demographic stress is linked to increases in terror (e.g. Burgoon 2006; Lai 2007; Piazza 2008a). We cannot state a relationship between the age structure and terror inclination, but as Heinson (2003) has argued, a large but aging population has a significantly reducing impact on the opportunity costs of terror.

A high degree of economic freedom deters terror in free countries, significantly so in Europe. This may indicate a trade-off between institutional opportunities and political violence, as detected by Basuchoudhary and Shughart (2007). In the Islamic world, the index is positively correlated with terror. As we have outlined in Section 2, the poor institutional environment of these countries (e.g. Kuran 2004) may have deprived individuals of economic opportunities, resulting in rather low opportunity costs of terror. Patents have a significantly negative impact on terrorist activities in OECD and Europe, but not so in the Islamic world, where we observe a positive impact. The interpretation may be that the number of patents granted in the United States is so low that an increasing number is rather making clear the technological gap and increases inclination to violence. This can be interpreted as further evidence to the argument of Dreher and Gassebner (2008) who show that the US and its allies are main targets of terror.

The overall explanatory power of the regression is quite reasonable throughout, as indicated by the value of the *LRI* and the pseudo- $R^2$ .

## 5. Conclusion

The results of our econometric analysis indeed support the theoretical reasoning. The proxies chosen to reflect the opportunity costs of terror have an impact on terrorism. Despite some puzzling results such as a positive impact of GDP per capita, we find that terrorist activities are clearly associated with socio-economic factors such as the population size as well as the institutional setting. One very important result is that there is a threshold of development with respect to macroeconomic performance, economic freedom and technological state. As long as this threshold is not surpassed, better performance rather encourages terror. After that, the usual interpretation of opportunity costs of terrorism holds; they matter, in particular with respect to the environment of potential terrorists. This evidence allows for modest policy conclusions deviating from rigid or violent counterterrorist strategies that rely on the “stick”, at least in the medium and long run. For our policy advice, we generally argue in favor of using the “carrot”, i.e. in favor of influencing the opportunity costs of terror in ways that reduce violence, as proposed by Frey and Luechinger (2003) and Frey (2004).

First and foremost, the results suggest that growth and better economic performance can help increasing the opportunity cost of terrorism. The sooner countries get rich, the better are the prospects of a peaceful future. This result is perfectly in line with what both trade theory and empirical evidence on trade suggest. Second, it may also be helpful to assess trade policy in the US and the EU towards the developing world under the given perspective. Third, institutions matter. Therefore, support for those forces in the countries in question who favor reform and modernization should be given. However, the actual implementation of the support is a tricky issue. If the support is perceived as being an imperialistic attack – e.g. because it is supported by military force – the opposite of the intended result may happen; Iraq may serve as a warning case in point. Instead of supporting reformers, terrorists who do not have an interest in the improvement of the economic situation at all may be strengthened by this strategy. Nevertheless, overcoming the institutional trap seems decisive for both the economic success of a country and for the fight against terrorism.

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**Appendix: Country Samples**

full sample:

AFG, ALB, DZA, AGO, ARG, AUS, AUT, BHS, BHR, BGD, BRB, BEL, BLZ, BEN, BOL, BWA, BRA, BGR, BDI, KHM, CMR, CAN, CAF, TCD, CHL, CHN, COL, ZAR, COG, CRI, CIV, CYP, DNK, DJI, DOM, ECU, EGY, SLV, EST, FJI, FIN, FRA, GAB, GER, GEO, GHA, GRC, GTM, GNB, GUY, HTI, HND, HKG, HUN, ISL, IND, IDN, IRN, IRQ, IRL, ISR, ITA, JAM, JPN, JOR, KEN, KWT, LAO, LVA, LBN, LTU, LUX, MDG, MWI, MYS, MLI, MLT, MUS, MEX, MAR, BUR, NAM, NPL, NLD, NZL, NIC, NER, NGA, NOR, OMN, PAK, PAN, PNG, PRY, PER, PHL, POL, PRT, ROM, RUS, RWA, SAU, SEN, SLE, SGP, SOM, ZAF, KOR, ESP, LKA, SWE, CHE, SYR, TWN, TZA, THA, TGO, TTO, TUN, TUR, UGA, UKR, ARE, GBR, USA, URY, VEN, YEM, ZMB, ZWE

OECD (current member countries):

AUS, AUT, BEL, CAN, DNK, FIN, FRA, GER, GRC, HUN, ISL, IRL, ITA, JPN, LUX, MEX, NLD, NZL, NOR, POL, PRT, KOR, ESP, SWE, CHE, TUR, GBR, USA

Europe (core European countries):

AUT, BEL, DNK, FIN, FRA, GER, GRC, ISL, IRL, ITA, LUX, NLD, NOR, PRT, ESP, SWE, CHE, GBR

Islam (countries with dominating Islamic religion):

AFG, ALB, DZA, BHR, BGD, TCD, DJI, EGY, IDN, IRN, IRQ, JOR, KWT, LBN, MLI, MAR, NER, OMN, PAK, SAU, SEN, SLE, SOM, SYR, TUN, TUR, ARE, YEM

Islam2 (excluding mainly oil producing gulf states):

AFG, ALB, DZA, BGD, TCD, DJI, EGY, IDN, JOR, LBN, MLI, MAR, NER, PAK, SEN, SLE, SOM, SYR, TUN, TUR, YEM

(number of observations not corresponding to the size of the country sample may be caused by missing data for some variables)

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