TOTAL ECONOMIC CONSEQUENCES OF TERRORIST ATTACKS: INSIGHTS FROM 9/11

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I. INTRODUCTION

Recent studies indicate that the make-up of economic consequences of terrorist attacks differs greatly from ordinary events and even other disasters. This paper provides an expanded framework for analyzing these distinctions. This includes an explicit role for resilience, behavioral linkages, remediation, mitigation, interdiction, and macroeconomic interactions. We illustrate the importance of including these factors by summarizing the results of recent studies of the September 11, 2001, terrorist attacks. This decomposition facilitates an evaluation of policy options that are most likely to lead to cost-effective reductions in future economic losses from terrorist attacks. An important conclusion of this paper is that we, rather than the perpetrators, are the major determinant of the consequences of a terrorist attack. After 9/11, our resilience was high, but so was our fear, both of which had profound effects on the bottom line, though in opposite directions. Government policy in the form of Federal Reserve action and fiscal policy reduced the losses significantly. However, subsequent anti-terrorist initiatives at home and abroad were more costly than the direct damage caused by the attack.

II. AN EXPANDED FRAMEWORK FOR ECONOMIC CONSEQUENCE ANALYSIS

Rose (2009) recently formulated an expanded framework for estimating economic consequences of terrorist attacks and natural disasters to account for several standard and expanded considerations that affect the overall outcome. Until recently, economic loss estimation focused almost entirely on standard target-specific (Direct) Economic Impacts and Loss of Life. The major expansions of the framework are the addition of Resilience and Extended Linkages, which greatly affect economic consequences. Resilience adjustments refer to actions that mute the initial shock and that hasten recovery. They have the effect of lowering direct business interruption, a major category of target-specific economic impacts. Extended Linkages refer to extreme behavioral reactions (such as fear of going to work or shopping in a high risk area) or cascading system failures (mainly through interdependent infrastructure). Direct Remediation costs can be especially large in the case of biological and radiological terrorist attacks and should be inserted into the analysis at an early stage, in part, because they, along with the two more standard features, are subject to indirect effects (often referred to as multiplier, general equilibrium, or macroeconomic effects). Mitigation and Interdiction costs can likewise be large in the form of extensive airport screening and military initiatives. The sum of all these positive and negative components yields a thorough bottom-line estimate of total economic consequences.

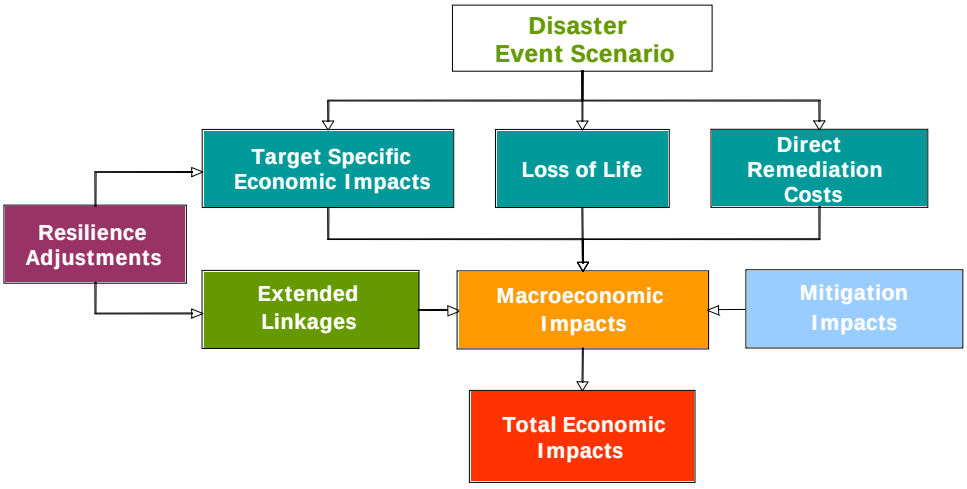

FIGURE 1. ECONOMIC CONSEQUENCE ANALYSIS FRAMEWORK

A. Resilience

Resilience refers to the ability of an entity or system to maintain function (e.g., continue producing) when shocked (see also Rose, 2007). It is thus aligned with the fundamental economic problem--efficient allocation of resources, which is made all the more challenging by a disaster. This aspect is interpreted as static because it can be attained without repair and reconstruction activities, which affect not only the current level of economic activity but also its future time path. Another key feature of static economic resilience is that it is primarily a demand-side phenomenon involving users of inputs (customers) rather than producers (suppliers). It pertains to ways to use resources available as effectively as possible. This is in contrast to supply-side considerations, which usually require the repair or reconstruction of critical assets.

A more general definition that incorporates dynamic considerations is the speed at which an entity or system recovers from a severe shock to achieve a desired state. This also subsumes the concept of mathematical or system stability because it implies the system is able to bounce back. This version of resilience is also more complex because it involves a long-term investment problem associated with repair and reconstruction.

Ability implies a level of attainment will be achieved. Hence, the definition is contextual--the level of function has to be compared to the level that would have existed had the ability been absent. This means a reference point or type of worst case outcome must be established first.[i]

B. Behavioral Linkages

Behavioral linkages refer to off-site responses to a disaster that manifest themselves in altered perceptions of risk that have economic consequences. These impacts, often unique to disasters, are not

typically captured in conventional models and can cause indirect impacts to be orders of magnitude greater than ordinary multiplier, general equilibrium, or macroeconomic effects. One key aspect stems from the "social amplification of risk," where, media distortion, increased risk aversion, or increased safety tolerances come in to play (see, e.g., Kasperson et al., 2003; Burns and Slovic, 2010). For example, terrorist contamination of the water supply of one city may cause operators of water systems in neighboring cities to shut down until testing has been completed. Even if this action is not taken, the situation may make households and businesses shy away from using tap water and thereby incur various additional costs of substitution or relocation. If a contagious agent is injected into the water system, this may cause people to avoid contact with others, such as withholding their children from school or not going to work.

Some forms of terrorism, especially repeated ones, can lead to a general social malaise that affects the economy, though some cultures (e.g., the UK and Israel) have been able to attain a new state of "normalcy" and lower level of economic losses after a time. Others, such as a "dirty bomb" or radionuclide contamination of the water system, can kill or injure large percentages of a population, leading to ghost towns that may not recover because of fear of lingering contamination or stigma (as in the case of the area around the Chernobyl nuclear power plant).

III. ECONOMIC IMPACTS OF 9/11

A collaborative research effort known as the Terrorism Economic Impact Modeling Forum (TEIMF) was recently completed to estimate the impacts of the September 11, 2001, Terrorist Attacks (Rose and Blomberg, 2009). Eight modeling teams contributed to the Project in an iterative research process that included: agreeing to a scope and set of basic assumptions and data, and then running, comparing and refining simulations and econometric tests. Participants also offered suggestions for improving each others' methodologies.

A. Overall Results

The range of estimates of the impacts of the September 11, 2001, Terrorist Attacks is rather small, suggesting a certain degree of precision in these findings, with the median being approximately $50 to $100 billion at the national level (see Table 1). The low estimate is approximately $35 billion dollars and the high estimate is approximately $109 billion. The one outlier is the study by Gordon et al., which admittedly was unable to distinguish the impacts of 9/11 from the on-going recession.[ii]

TABLE 1. ECONOMIC IMPACTS OF THE SEPTEMBER 11 TERRORIST ATTACKS

(in billion 2006$)

Team/ Time Period	Geographic Area	Gross Domestic Product (unless otherwise noted) Upper Bound[a] Level	%	Average Level	%	Lower Bound[b] Level	%	Scope
Rose et al. 2001-02 (value added)	U.S.			$109	1.0			Shocks only
Werling & Horst 2001-02	U.S.	$246	2.1	$94	0.8	$37	0.3	Shocks & response
Park et al. 2001-02	U.S.	$549[c]	4.7	$275	2.4	$0[d]	0.0	Shocks & recession
Blomberg & Hess 2001 only	U.S.	$122	1.1	$58	0.5	$23	0.2	Shocks & response
Treyz & Leung 2006-2020	U.S.			$18	0.2			Shocks only
Roberts 2001 only	U.S.			$56	0.5			Shocks & response

[a]Typically involves assumptions of low levels of resilience.
[b]Typically involves assumptions of high levels of resilience.
[c]Ascribes all national and NYC Metro Region losses to 9/11, and none to the national recession.
[d]Ascribes no national and NYC Metro Region losses to 9/11, and all to the national recession.

B. Decomposition: Resilience and Behavioral Linkages

Here we focus on one of the papers in which the analytical framework was applied to the estimation of the economic consequences of the 9/11 attacks on the World Trade Center (WTC) using a computable general equilibrium model (Rose et al., 2009). This was a “bottom-up” analysis that more readily lends itself to a decomposition of the main results.

The analysis indicated that *potential* direct business interruption (BI) losses were on the order of $43 billion in GDP, but that, because 95% of the more than 1,100 businesses located in the WTC area were able to relocate rather quickly, the direct BI losses were only $12 billion (as associated with the "downtime"). Indirect (general equilibrium) BI amounted to $14 billion. Thus, the direct resilience of the economy with respect to business relocation was 72% [(43-12)/43].

The largest single impact of the event was due to the fear factor manifesting itself in a reduction in air travel and related tourism for nearly two years after the event. After adjusting for the pre-existing downturn in airline travel, this amounted to $50 billion of direct BI and $60 billion of indirect BI. Thus, extended linkages accounted for more than 80% of the total loss of GDP due to the event.

IV. OTHER IMPACTS

Other factors contributing to the impacts are summarized below. Many of the estimates were generated by "top-down" macroeconomic analyses as part of the TEIMF Project, as well as from related studies on 9/11.

A. Property Damage and Remediation

Grossi (2009) found that there was $22.7 billion loss to property in and around the WTC complex as a result of the terrorist attacks. The New York City's Comptroller's Office estimate "to replace the buildings, infrastructure and other amenities" was $22 billion (Wray, 2008). Bram et al. (2009), in a comprehensive study estimated that the cost of cleaning up the site, replacing the destroyed World Trade Center buildings, and repairing damaged buildings and infrastructure would be $22.7 billion.

B. Macroeconomic

The TEIMF study by Blomberg and Hess (2009) used a method that compared the impact of terrorist attacks at different points in time in different regions of the world relative to those times and places at peace to estimate the economic cost of September 11. They estimated the short-term effects using panel regression techniques and then conducted a series of robustness checks using VARs, quantile regressions, and welfare simulations. Using a panel regression they first estimated the impact of the September 11 attacks to be approximately a 0.50 percentage point decrease in GDP growth, or $60 billion (2006 dollars). The estimate is robust across VARs, quantile regressions or welfare simulations.

The baseline OLS results include contemporaneous terrorism and lagged terrorism, lagged GDP, lagged investment share, time and country fixed effects. These results show that the impact of 9/11 on growth is significant with approximately a negative 0.5 percentage point impact on GDP per capita growth. Alternative specifications were considered with little to no difference in the qualitative results.

Because the macroeconomic impact of terrorism may be different on 9/11 than the average impact, they used a quanitile regression technique to estimate the impact on different parts of the distribution. Using absolute deviations at the 70^{th} fractile, the impact estimate is a negative 0.44 percentage point impact on GDP per capita, nearly identical to the OLS estimate.

A structural VAR model was used to estimate the residual impacts for output, terrorism, external conflict and internal conflict. The impact using the VAR is also quite similar to the OLS and quanitile estimation, negative 0.48 percentage point impact on GDP per capita. In dollar terms, both the quantile regression and VAR estimates show that the impact of 9/11 is approximately a loss of $60 billion to the United States.

Blomberg and Hess (2009) also estimated the impact of terrorism on lost welfare by tranforming utility into lost GDP growth. They assumed a discount rate of 8 percent and constant relative risk aversion of 2, which are standard in the literature. The general qualitative results are not sensitive to slight deviations in these parameters. In each of these cases, the entire reduction due to the September 11 attacks is approximately $80 billion.[iii]

C. Monetary and Fiscal Policy

There are significant challenges in distilling the impact of the attacks on September 11 from other negative factors, as the Year 2001 was marked with corporate scandals and the headwinds of a recession.. There were also monetary policy adjustments demonstrated by the increase in the funds rate to 6.25 percent in December 2000.

The empirical exercise is further complicated by expansionary monetary and fiscal policies that followed shortly after 9/11. This was seen in the reversal of Federal Reserve policy as the federal funds rate was reduced to its lowest point ever (at the time), or 1 percent through June 2003, and the fiscal expansion demonstrated by the Bush tax cuts of 2001-3. The Federal Reserve emphasized its vigilance of the financial sector by interjecting a then unprecedented $100 billion into the banking system in particular because of the disruption of interbank payments. Lacker (2004) suggests that had the Fed acted in a less aggressive manner, the stock market might have dropped much more than it did and the crisis might have expanded to the broader financial system.

D. Mitigation/Interdiction

Scholarly debate about the economic costs of military intervention focuses on long-term security and rebuilding considerations, human capital and infrastructure losses, and many other direct and indirect costs of war. Nordhaus (2002) considered two potential scenarios ranging from a short conflict to a more prolonged conflict to include expensive postwar reconstruction and occupation. He finds that the cost to the United States would range from $100 billion to $1.9 trillion over the next decade. Subsequent research has found similar wide-ranging estimates (see Bilmes and Stiglitz 2008; and Davis et al., 2006).[iv]

Still, two conceptual considerations dominate this aspect of the analysis. The first is whether mitigation actions should be considered in relation to future events or the one that stimulates them. We suggest that they are appropriately considered as a cost of 9/11. The second is the open question of whether the Iraq War was primarily a reaction to 9/11 or primarily motivated by other objectives. We pass no judgment on this matter here (cf., Nordhaus, 2002).

V. POLICY LESSONS

Even though the impacts of the September 11 Terrorist Attacks were relatively small, they could have been diminished further. We need to maintain and enhance our resilience, quell our fears, and target government macro policy and mitigation where it is most effective. The following lessons provide some guidance for future efforts to reduce the economic consequences of terrorism:

- Ordinary markets for goods and services and individual initiative are major sources of resilience and worked in the aftermath of 9/11. Individual businesses survived by relocating quickly and individual consumers made many worthy adjustments.

- Financial markets require immediate attention and support. The macroeconomy benefited from countervailing monetary and fiscal policy as well.

- Fear translated into negative economic consequences. Efforts need to be made to improve the accuracy of reporting of events. Governments need to find ways to communicate the strengths and limitations of their capabilities to protect it.

- Market and government failures need to be corrected to reduce the costs and improve the effectiveness of mitigation. Government policies should not undercut private initiative. Government agencies need to work more effectively together to shore up gaps and avoid duplication.

ENDNOTES

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[i] Several studies have found resilience to be sizeable in short-term or limited cases, such as water and electricity outages following earthquakes (Tierney, 1997; Rose and Liao, 2005) and terrorist attacks (Rose et al., 2007). Back-up systems, price adjustments, production rescheduling were found to be major sources of resilience, and relatively inexpensive as well. Flynn (2008) has emphasized the "empowering" nature of resilience that inspires individuals to rally in the aftermath of extreme events. This represents a major resource as well and lessens the need for government actions and expenditures to deal with disasters.

[ii] Early estimates by Looney (2002) put the cost of lost physical assets to be "$14 billion for private businesses, $1.5 billion for state and local government enterprises and $0.7 billion for federal enterprises. … The implied projected cumulative loss in national income through the end of 2003 amounted to 5 percentage points of annual GDP, or half a trillion dollars." Others have made more conservative estimates. Bernasek (2002) estimates business costs associated with the attack to be as much as $151 billion. The International Monetary Fund (2001) found that "the loss of output from all these sources could be as much as ¾ percent of GDP," or approximately $75 billion in 2001 dollars.

[iii] It is also worthwhile to note that these analyses are consistent with those of other research teams participating in the TEIMF Project (Rose and Blomberg, 2009). Werling and Horst (2009) integrates feature of macroeconometric, input-output, and general equilibrium models, which allow for full industrial detail and a consistent representation of the macroeconomy. They show that compared to the shocks imposed on the model, the net, six-year effect on overall real GDP is relatively small--$35 billion, or about 0.3 percent of GDP in 2001. Roberts (2009) makes a significant departure from other approaches by analyzing how economic forecasters themselves estimated the economic consequence. Real-time forecast evidence suggests that the short-run macroeconomic impacts of the 9/11 attack were a reduction in real GDP growth in 2001 of 0.5 percent.

[iv] Estimating the cost of the war to the citizens of Iraq has received some attention as well (see IMF, 2003; Foote et al., 2004). Blomberg and Engel (2009) study losses due to increased price uncertainty in Iraq following the war by investigating the impact on prices during the war and during the troop surge. For the country as a whole, average price dispersion was 24 percent in the weeks before the surge, 22 percent during the weeks of the surge, and 23 percent in the weeks after the surge. These summary statistics suggest that the surge reduced average price dispersion by about 2 percentage points, from the pre-surge level. They also find that average price dispersion falls except two Shia regions during the surge and subsequently increases except in three Sunni regions. This degree of price uncertainty is significantly higher than that found previously using similar data in Japan, about12 percent (see Chueng and Fujii, 2008).

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