USC CREATE
HOMELAND SECURITY CENTER

FY2015 Annual Report

Economic Consequence Analysis Tool (E-CAT)

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Contents

1. Executive Summary

The purpose of this project is to develop and transition a methodology for rapidly obtaining approximate estimates of the economic consequences from the nearly 40 threats listed in the Homeland Security National Risk Characterization (HSNRC) Risk Register. The tool is intended for use by various DHS components and offices to obtain estimates almost instantly. It is programmed in Excel and Visual Basic for Applications (VBA) to facilitate its use. This tool is called E-CAT (Economic Consequence Analysis Tool) and accounts for the cumulative direct and indirect impacts (including resilience and behavioral factors that significantly affect base estimates) on the national economy from terrorism, natural disasters, and technological accidents. E-CAT is intended to be a major step toward advancing the current state of economic consequence analysis (ECA) across DHS, and also contributing to and developing interest in further research into fast turnaround approaches.

The essence of the methodology involves running numerous simulations in a computable general equilibrium (CGE) model for each threat, yielding synthetic data for the estimation of a single regression equation based on the identification of key explanatory variables (threat characteristics and background conditions). This transforms the results of a complex model, which is beyond the reach of most users, into a "reduced form" model that is readily comprehensible. We have built functionality into E-CAT so that its users can switch various consequence categories on and off in order to create customized profiles of the economic consequences of numerous risk events. E-CAT incorporates uncertainty on both the input and output side in the course of the analysis. A premium has been placed on making E-CAT user friendly and transparent.

This project is a major milestone in CREATE's 10-year progression of research on ECA and leverages its recent research for the Office of Health Administration National Biosurveillance Integration Center (OHA/NBIC) and the Defense Nuclear Detection Office (DNDO). It builds upon recent research for DHS on developing a reduced form modeling for selected threats and developing a user-friendly spreadsheet program to facilitate the performance of ECA. It also

incorporates insights from the completion of nearly 2 dozen ECA case studies, including definitive estimate of the economic impacts of the September 11 World Trade Center attack and simulation studies of a dirty bomb attack on the Los Angeles financial district, the shutdown of a major port complex in Texas, and a catastrophic Southern California earthquake, among others. In the course of developing E-CAT, the research team made several innovations, some of which overlapped with related studies to be discussed below. We developed an "Enumeration Table" of various types of economic impacts that are potentially associated with each threat. This provides a checklist that helps ensure that each ECA's comprehensive. We also updated and refined the CREATE US CGE Model for the purpose of the analysis. We developed an approach and the computer code for running hundreds of Monte Carlo simulations of the economic consequences of individual threats. We incorporated uncertainty into the analysis in relation to both inputs and results. We are also in the process of completing a sophisticated validation analysis using several techniques. Finally, we developed a user-friendly interface in Excel/VBA that will facilitate widespread use.

We have currently incorporated 10 major threats (including, nuclear attack, earthquakes, pandemic influenza, floods, and transportation system disruptions among others) into E-CAT. We plan to develop another 20 threats once we have completed our assessment of feedback from potential users. In addition to developing the software, our analyses have provided new insights into the importance of various explanatory factors, especially resilience and behavioral linkages, in the bottom-line consequences of individual threats.

E-CAT was originally intended for primary use by the DHS Policy Office. However, it is also an ideal tool for more widespread use by those who need a quick turn-round capability to compare the economic consequences of many threats for decisions relating to resource allocation for mitigation and resilience and the disbursement of post-disaster assistance. Interest in the tool has been expressed by FEMA, US Coast Guard, and Los Angeles Mayor's Office. CREATE will offer a short course for DHS staff, as well as other interested parties, and help advance the process of harmonization of modeling of economic impacts for various risk assessments. The Science and Technology (S&T) Office of University Programs (OUP) will help tailor and shape the course materials for offering it to a broad set of risk and consequence analyst communities.

E-CAT is ideal for use risk assessments and risk management decisions. It is intended to be easy to use, quick, reasonably accurate, and transparent. It also incorporates functionality such that end users can create tailor-made profiles of economic consequences of a broad range of threats, with associated measures of uncertainty. Recently, E-CAT received CREATE's Transition Product of the Year Award.

Research on E-CAT has overlapped with several other current and recent projects. These include DHS OHA/NBIC on broadening the range of impacts it considers (Rose et al., 2015) and the Defense Nuclear Detection Office (DNDO) on analyzing the duration and time-path of radiological/nuclear events (Heatwole et al., 2014). It builds upon prior work on developing a reduced form model to predict the economic consequences of earthquakes (Heatwole and Rose, 2013) and reduced form modeling for DNDO. It also builds on the CREATE Urban Commerce and Security (UCASS) Project as well, where CREATE developed a user-friendly spreadsheet program to facilitate the performance of ECA (Rose et al., 2014).

2. Research and Research Transition Accomplishments

2.1. Research Results

The E-CAT Tool research framework consists of 7 steps as outlined in Figure 1. First, Enumeration Tables for each threat are filled out according to upper and lower bounds identified from searches of relevant historical data of prior threat incidents, related literature, and/or expert judgment. Second, lower and upper bound Direct Impact numerical values are estimated for each of the Enumeration Table categories that are determined to be above the "Low Influence" threshold.

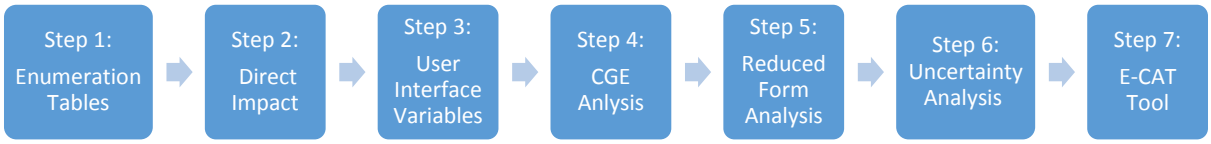

Figure 1. Seven-step E-CAT Research Framework

Third, unique sets of User Interface Variables are identified for each threat and grouped under the following categories: Magnitude, Time of Day, Duration, Economic Structure, Location, Other, Behavioral Avoidance, Behavioral Aversion, Resilience Recapture, and Resilience Relocation. Randomized draws of 100 User Interface Variable combinations generate uniformly distributed values between range boundaries for the Magnitude variable and different options for the other variables relevant to each threat. These 100 random draws are then converted to computable general equilibrium model (CGE) inputs via a series of linkages.

Fourth, CGE model simulations are run for each of the 100 random draw scenarios. The identified relevant Direct Impact values are input into our USCGE Model, which captures the combined and interactive effects of these impacts through price changes and substitution effects across multiple economic institutions – 58 sectors, 9 household groups, government institutions, and international traders. GDP and employment impacts for up to the first year of consequences are generated for each of these 100 scenarios, and, where relevant, the Economic Structure of the impacted region is also factored in by scaling the national average results across three different example regional economy structures to render 400 unique GDP and employment results.

Fifth, multivariate regression analysis is conducted to estimate the influence of each of the User Interface Variables on the dependent variables of GDP and employment impacts. This analysis produces a reduced-form equation on the basis of Ordinary Least Squares and Quantile regression analysis, allowing for estimates of mean, 5^{th} percentile, 25^{th} percentile, 50^{th} percentile, 75^{th} percentile, and 95^{th} percentile results.

Sixth, these reduced-form equations are combined to model the mean response and uncertainty surrounding the GDP and employment results for any given combination of User Input Variables. Uncertainty distributions are determined by user inputs of the parameters of a triangle distribution (i.e. a lower-bound, a mid-point, and an upper-bound) for the Magnitude variable, alongside user inputs of the other variables for that particular threat. Model validation procedures are underway.

Seventh, the coefficients from the reduced-form equations are input into the E-CAT Tool. The Tool is designed to be a user-friendly interface with which to explore the deterministic and probabilistic results of the reduced-form analysis of the CGE modeling for each threat. Users first select a threat and the level of detail for the results they would like. The resulting E-CAT Tool User Interface provides an Input Area, whereby the user selects values for each of the relevant User Input Variables, and an Output Area. Economic impact results for GDP and employment are presented in both tabular and graphical formats and with respect to both point estimates and distributions.

2.2. Research Transition

Estimates of economic consequences of threats to the US are an integral part of risk assessment and risk management decisions. Essentially, the benefits of various mitigation and resilience strategies are the consequences that they prevent. Until a few years ago, most economic consequence analysis was performed using the simplistic approach that only included ordinary direct effects (death/injuries, property damage, and direct business interruption), and then applied simple multiplier models to estimate indirect effects. CREATE's research has shown that other major considerations have a large bearing on bottom-line economic consequence analysis results (Rose, 2009; Rose, 2015).

Recently, there is a growing awareness that this broader range of economic consequences needs to be considered. These include *behavioral reactions* (see, e.g., Giesecke et al., 2012) and activities associated with *decontamination* or *remediation* (see, e.g., Baker et al., 2008; Heatwole et al., 2015), which can increase the cost of disasters considerably. In addition, it is important to take into account *resilience*, which can dampen losses considerably (see, e.g., Rose, 2009b). These important considerations have been incorporated into the comprehensive Economic Consequence and Analysis Framework developed at CREATE (see Figure 2) (Rose, 2009a; Rose, 2015).

Major initiatives are underway at DHS and other federal agencies to broaden the scope of ECA. This includes research done by the Rose Research Team on broadening the range of impacts considered by NBIC (Rose et al., 2015), research by the Team, in conjunction with the research team of CREATE affiliate Peter Dixon, on incorporating some of these aspects in DNDO analyses (Heatwole et al., 2014), broadening the range of impacts considered by NBIC (Rose et al., 2015), and a new project to begin this year headed by Peter Dixon developing the next generation of Terrorism Risk Analysis (TRA) for cam/bio/rad/nuke threats. In addition, Adam Rose has been appointed to an EPA Scientific Advisory Board Panel on "Economy wide Impacts," which addresses prospects for incorporating some of these broader impacts into rule-making in relation to air pollution issues.

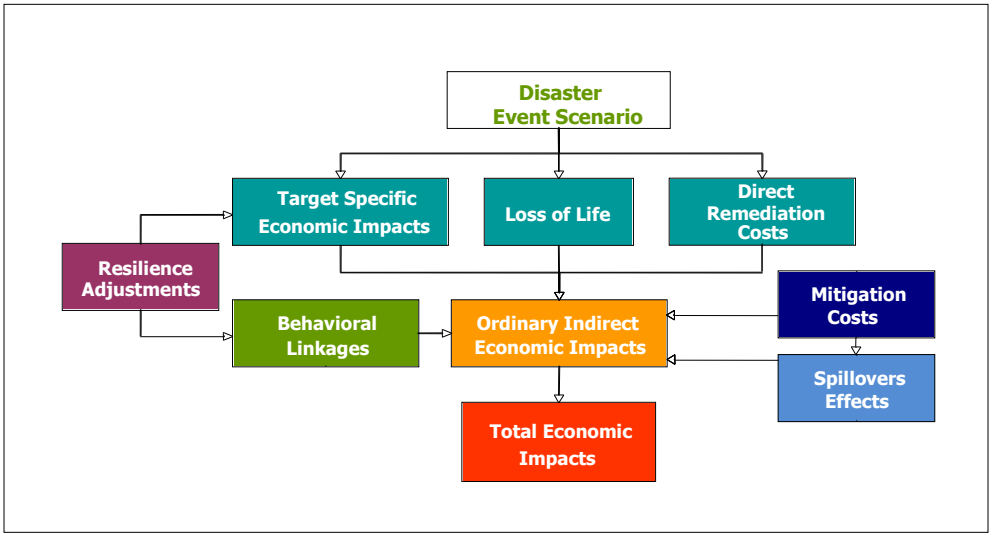

Figure 2. Economic Assessment Framework Overview

Studies have shown that these broader factors can have sizable influence on the bottom-line. For example, Rose et al., (2009) found that it's resilience to relocation in the aftermath of the World Trade Center attacks reduce potential business interruption (BI) losses by 72%. At the same time, the almost two-year reduction in airline travel and related tourism following the attack was responsible for more than 80% of the remaining BI losses. Rose (2015) contrasts the sizeable relative differences in the role of resilience and behavioral responses in a study of six major bio threats. The results indicate that rules of thumb cannot be applied to the estimation of total economic consequences, and that a formal modeling approach is needed.

At the same time, the majority of CREATE's research on ECA has involved the use of sophisticated models, such as computable general equilibrium, consisting of thousands of equations that are beyond the reach of potential users. The E-CAT Tool has transformed this complexity into a reduced-form regression equation for each threat, which is transparent to wide range of users.

Although E-CAT was originally formulated to respond to the needs of the DHS Policy Office, its overall design and user-friendly interface makes it accessible to broad range of users, including other federal agencies, state and local government emergency management, and industry. Any analyst or policymaker that requires a rapid estimate of a single or wide variety of threats can readily use E-CAT to obtain bottom-line estimates. These can be combined with probabilities of occurrence in risk assessment and with mitigation costs in a benefit-cost analysis. Potential issues that can be addressed in the areas of risk assessment and risk management include: comparison of relative risks, allocation of resources for mitigation and resilience across numerous threats, emergency response allocations, and the disbursement of post-disaster assistance.

The E-CAT User Interface The tool is based on Excel and Visual Basic for Application (VBA). Three different economic impact options are developed for each type of threat, including a point

estimate (Option 1), interval estimate (Option 2) and uncertainty distribution (Option 3). Step-by-step instructions are presented in a User's Guide.

The master *User Interface* page, as illustrated in Figure 3, is designed to allow the user to specify the types of threat and option. For instance, when a user specifies the threat as "Human Pandemic" and the option as "Point Estimate", the *Results* page illustrated in Figure 4 will be presented automatically with this combination. The user can return to the main menu by clicking the "Main Menu" button on the top right of each option page. The result can also be printed automatically when the button "Print Results" is clicked.

The Point Estimate option allows the user to calculate the economic impact of a specified threat type in terms of GDP and employment losses based on a single magnitude input variables, as well as other user input variables see again Figure 4). Relevant user options are highlighted in yellow color boxes, whereas grey boxes are not applicable for the specified threat type. For instance, in the case of Option 1 for the Human Pandemic, the user is provided with input variable selections in terms of Magnitude, Duration, Behavioral Avoidance, Behavioral Aversion and Resilience (each of these is defined in the green boxes). After the input specification, the results are presented in the white color area, which includes both numerical values and cumulative distribution charts for both GDP loss and employment loss, by value and percent, respectively.

The interval estimate (Options 3) allows the user to calculate the economic impact in terms of GDP loss and employment loss based on a given range of the magnitude input variable, together with other user input variables. The key difference between Option 1 and 2 is that the latter

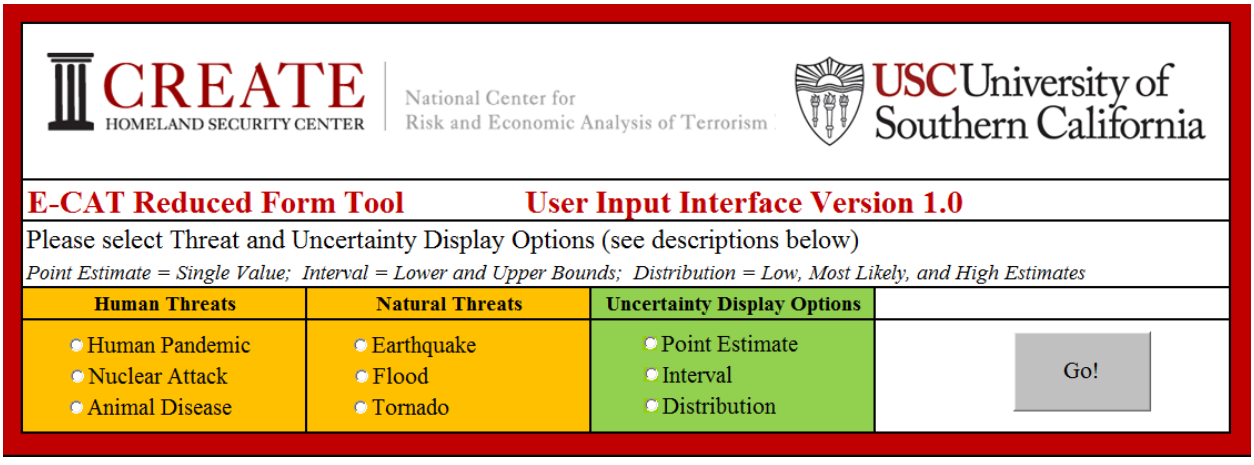

Figure 3. E-CAT Tool User Interface

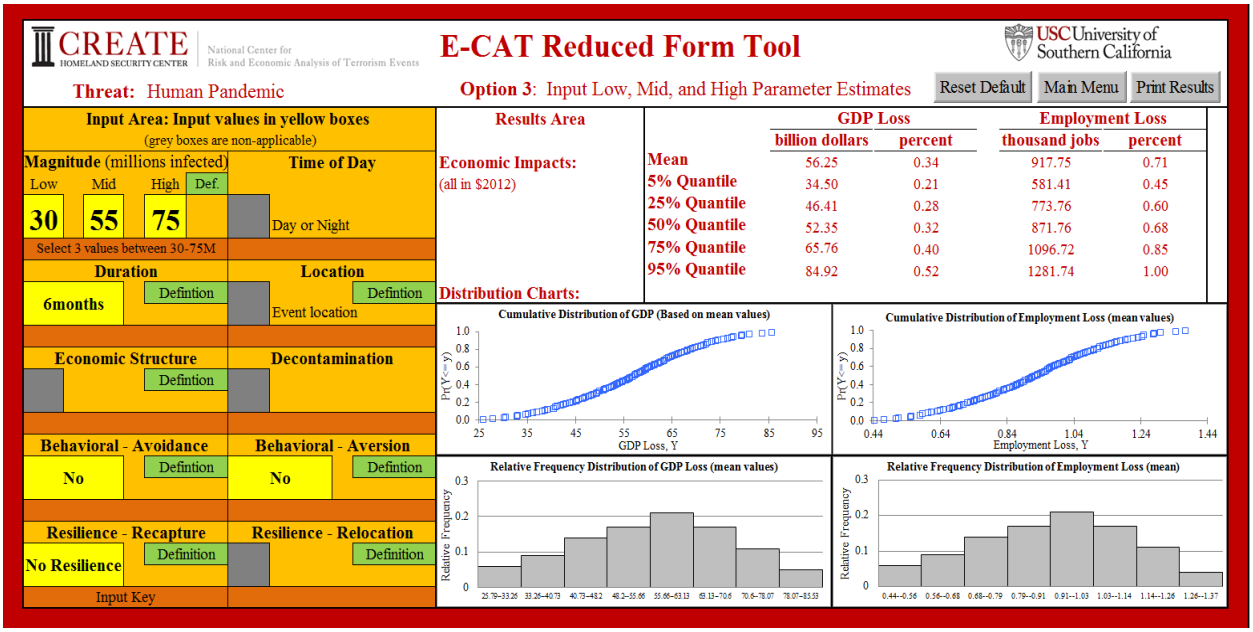

Figure 4. E-CAT Tool Sample Results for Human Pandemic

allows the user to provide both a lower bound and an upper bound magnitude input, and the economic impact of both value are presented in the results area automatically. The uncertainty distribution estimate (Option 3) allows the user to calculate the economic impact in terms of GDP and employment losses based on the triangular distribution of the magnitude input variables, together with other user input variables. The user is requested to specify lower, middle and upper bounds of the magnitude values, as well as duration, avoidance, aversion and resilience. The economic impact in terms of GDP loss and employment loss are also displayed automatically in the results area. In addition, the cumulative frequency distribution charts and the relative frequency distribution charts of the mean values of GDP loss and employment loss are presented.

E-CAT is based on a careful assessment of direct impact drivers, computable general equilibrium (CGE) analysis to estimate indirect impacts, and reduced-form regression analysis to translate the complex analysis into a compact form that can yield quick-turn results under various assumptions relating to background conditions and the direct drivers, under various representations of uncertainty. Uncertain threat inputs are quantified and propagated through the analysis process resulting in appropriate representations of economic consequence uncertainties as output. E-CAT accounts for the cumulative direct and indirect impacts (including resilience and behavioral factors that significantly affect base estimates) on the national economy for numerous threats, including terrorism, natural disasters, and technological accidents.

E-CAT is being considered for use by TSA, FEMA, the US Coast Guard, and the California Office of Emergency Services. A supplement to FY 16 funding for the Rose Research Team has been provided by the Coast Guard to refine E-CAT to evaluate maritime cyber threats. We can tailor E-CAT for other specialized users as well.

References

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Geisecke, J., W. Burns, A. Barrett, E. Bayrak, A. Rose, P. Slovic and M. Suher. 2012. "Assessment of the Regional Economic Impacts of Catastrophic Events: A CGE Analysis of Resource Loss and Behavioral Effects of a Radiological Dispersion Device Attack Scenario," *Risk Analysis* 32: 583-600.

Heatwole, N, and A. Rose (2013) "A Reduced-Form Rapid Economic Consequence Estimating Model: Application to Property Damage from U.S. Earthquakes." *International Journal of Disaster Risk Science, 4*(1): 20-32.

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Rose, A. 2009a. "A Framework for Analyzing and Estimating the Total Economic Impacts of a Terrorist Attack and Natural Disaster," *Journal of Homeland Security and Emergency Management* 6: Article 4.

Rose, A. 2009b. *Economic Resilience to Disasters*, Community and Regional Resilience Institute Report No. 8, Oak Ridge National Laboratory, Oak Ridge, TN.

Rose, A. 2015. Macroeconomic Consequences of Terrorist Attacks: Estimation for the Analysis of Policies and Rules," in C. Mansfield and V.K. Smith (eds.), *Benefit Transfer for the Analysis of DHS Policies and Rules*, Cheltenham, UK: Edward Elgar.

Rose, A., M. Avetisyan, and S. Chatterjee. 2014. "A Framework for Analyzing the Economic Tradeoffs between Urban Commerce and Security," *Risk Analysis* 34(5): 1554-79.

Rose, A., B. Lee, G. Oladosu, and G.R. Beeler Asay. 2009. "The Economic Impacts of the September Terrorist Attacks: A Computable General Equilibrium Analysis," *Peace Economics, Peace Science, and Public Policy*, 15(2): Article 4.

Rose, A., F. Prager, D. Wei, and S. Lahri. 2015. Broadening Economic Modeling for Biosurveillance Analysis. Final Report to the National Biosurveillance Integration Center (NBIC), National Center for Risk and Economic Analysis of Terrorism Events (CREATE), University of Southern California.

2.3. Publications, Reports and Presentations

CREATE PUBLICATIONS	Referred	Not Referred	PDF Sent to CREATE	Permission to Publish from Copyright Holder?
Rose, Adam – University of Southern California – CREATE				
1. Rose, A. and C. Huyck. 2015. "Improving Catastrophe Modeling for Business Interruption Insurance Needs," *Risk Analysis*, forthcoming.	X			
2. Prager, F., A. Rose, D. Wei, B. Roberts, and C. Baschnagel. 2015. "Economy-wide Impacts of Reduced Wait Times at U.S. International Airports," *Research in Transportation Business and Management*, forthcoming.	X			X
3. Sue Wing, I. A. Rose, D. Wei and A. Wein. 2015. "Impacts of the USGS ARkStorm Scenario on the California Economy," *Natural Hazards Review*, forthcoming.	X			X
4. Avetisyan, M., N. Heatwole, A. Rose, and B. Roberts. 2015. "Competitiveness and Macroeconomic Impacts of Reduced Wait Times at U.S. Land Freight Border Crossings," *Transportation Research A*, 78: 84–101.	X		X	X
5. Rose, A., M. Avetisyan, and S. Chatterjee. 2014. "A Framework for Analyzing the Economic Tradeoffs between Urban Commerce and Security," *Risk Analysis* 34(5): 1554-79.	X		X	X
6. Rose, A. 2015. "Economic Resilience to Terrorism and Natural Disasters," in A. Abbas, M. Tambe and D. von Winterfeldt (eds.), *CREATE Handbook on Decision and Risk Analysis of Terrorism*, forthcoming.	X			
7. Dixon, P., M. Rimmer and G. Wittwer, A. Rose and N. Heatwole. 2015. "Economic Consequences of Terrorism and Natural Disasters: The Computable General Equilibrium Approach," in A. Abbas, M. Tambe and D. von Winterfeldt (eds.), *CREATE Handbook on Decision and Risk Analysis of Terrorism*, forthcoming.	X			
8. Roberts, B., A. Rose, N. Heatwole, D. Wei, M. Avetisyan, F. Prager, C. Baschnagel, and I. Maya. 2015."Economic Impacts of Changes in Wait Times at U.S. Ports of Entry," in A. Abbas, M. Tambe and D. von Winterfeldt (eds.), *CREATE Handbook on Decision and Risk Analysis of Terrorism*, forthcoming.	X			
9. Rose, A. 2015. "Economic Resilience to Disasters, in B. Ayyub (ed.), *Economics of Community Disaster Resilience*, National		X		

CREATE PUBLICATIONS	**Referred**	**Not Referred**	**PDF Sent to CREATE**	**Permission to Publish from Copyright Holder?**
Institute of Standards and Technology, Gaithersburg, MD, forthcoming.				
10. Rose, A. 2015. "Macroeconomic Consequences of Terrorist Attacks: Estimation for the Analysis of Policies and Rules," in C. Mansfield and V.K, Smith (eds.), *Benefit Transfer for the Analysis of DHS Policies and Rules*, Cheltenham, UK: Edward Elgar, pp. 172-201.	X		X	X
11. Geisecke, J., W. Burns, A. Rose, A. Barrett, and M. Griffith. "Economic Consequences of a Chlorine Terrorist Attack in the Los Angeles Financial District: Regional Dynamics under Adverse Physical and Behavioral Shocks," in P. Nijkamp et al. *Regional Science Matters: Studies Dedicated to Walter Isard*, Heidelberg, Germany: Springer, pp. 319-50.	X		X	X
12. Rose, A. 2015. *Private Sector Co-Benefits of Disaster Risk Management*. Final report to the World Bank.	X			
13. Rose, A., F. Prager, Z. Chen and S. Chatterjee. 2015. *Economic Consequence Analysis Tool (E-CAT)*. Final Report to DHS, CREATE, USC, Los Angeles, CA.		X		X
14. Rose, A., F. Prager, D. Wei, and S. Lahri. 2015. *Broadening Economic Modeling for Biosurveillance Analysis*, Final Report to the National Biosurveillance Integration Center, CREATE, USC.		X		X
15. Heatwole, N., A. Rose, D. Wei, P. Dixon et al. *Modeling the Temporal and Spatial Consequences of Nuclear Terrorism Events*, final report to the Domestic Nuclear Detection Office (DNDO), CREATE, USC, November 2014.		X		X
16. Rose, A. and N. Dormady. 2014. *Israeli-Palestinian Land Swap Auction Model*. Final Report, RAND Intelligence Policy Center.	X			

CREATE OUTREACH PRESENTATIONS
Rose, Adam – University of Southern California – CREATE
1. Avetisyan, M., N. Heatwole, A. Rose, B. Roberts, "Macroeconomic Impacts of Reduced Wait Times at U.S. Land Freight Border Crossings," invited seminar, Cross-Border Institute, University of Windsor, Windsor Ontario, October 2014.
2. Rose, A. "Co-Benefits of Disaster Risk Management," Invited plenary presentation, National Institute of Building Sciences Annual Symposium, Washington, DC, January 2015.

CREATE SCHOLARLY/CONFERENCE PRESENTATIONS

Rose, Adam – University of Southern California – CREATE

1. Rose, A. "Developing an Index of Economic Resilience,"
   Invited presentation, World Bank Resilience Indicator Workshop, (webinar) July 2014
   Invited plenary presentation, National Institute of Building Sciences Annual Symposium, Washington, DC, January 2015.
   Invited presentation to the Disaster Resilience Roundtable, National Academy of Sciences, Irvine, CA, February 2015.
2. Rose, A. "Economic Consequence Analysis: Are We Measuring the Right Things?"
   Invited plenary presentation, Annual Conference of the International Society for Integrated Disaster Risk Management, London, Ontario, October 2014
   Invited presentation, GNS Crowne Research Institute, Wellington, NZ, December 2014.
   Invited presentation, Annual Conference of the Society for Risk Analysis, Denver, CO, December 2014.
3. Rose, A., M. Avetisyan, O. Chan, H. Rosoff, W. Burns and P. Slovic. "The Role of Behavioral Responses in the Total Economic Consequences of Terrorist Attacks on U.S. Air Travel Targets," presented at the Annual Meeting of the Society for Integrated Risk Management, London, Ontario, October 2014.
4. Rose, A. "Computable General Equilibrium Analysis for Terrorism Consequence Analysis," invited seminar presented to the U.S. Department of Homeland Security, Economic Consequence Analysis Interagency Working Group, (webinar) October 2014.
5. Rose, A. "An Overview of the Economic Consequence Analysis Tool (E-CAT), invited seminar presented to the U.S. Department of Homeland Security, Economic Consequence Analysis Interagency Working Group, (webinar) November 2014.
6. Rose, A. "The Value of America's Ports," invited presentation, Maritime Risk Symposium, Los Angeles, CA, November 2014.
7. Rose, A. et al., "Economic Consequences of a Ban on Rail Shipments of Chlorine in the US as a Response to a Terrorists Threat," invited presentation at the Annual Meetings of the North American Regional Science Council, November 2014, Washington, DC.
8. Rose, A. "Assessing the Benefits of Infrastructure Resilience" Forum with Professor Adam Rose, National Infrastructure Unit, New Zealand Department of the Treasury, Wellington, NZ, December 2014.
9. Rose, A. "Measuring Economic Resilience to Disasters," invited plenary presentation, National Institute of Standards and Technology Economics of Community Disaster Resilience Workshop (joint with ASCE and ASME), Reston, VA, April 2015.
10. Rose, A. and L. White. "Measuring Economic Resilience to the Christchurch Earthquakes," invited seminar, University of Canterbury, Christchurch, NZ, June 2015.

2.4. Models, Databases, Software Tools, Invention Disclosures and Patents

The Economic Consequence Analysis Tool (E-CAT) accounts for the cumulative direct and indirect impacts (including resilience and behavioral factors that significantly affect base estimates) on the national economy from terrorism, natural disasters, and technological accidents. Implementation of E-CAT in Excel and VBA makes the tool accessible to a wide variety of users.

E-CAT is being considered for use by TSA, FEMA, the US Coast Guard, and the California Office of Emergency Services. A supplement to FY 16 funding for the Rose Research Team has been provided by the Coast Guard to refine E-CAT to evaluate maritime cyber threats. We can tailor E-CAT for other specialized users as well.

Research Products Transitioned to Governmental Agencies

RESEARCH PRODUCTS					
Project Leader(s)	**Date Delivered**	**Item**	**Agency Receiving Product**	**Agency POC**	**Transitioning Status**
Rose	Economic Consequence Analysis Tool (E-CAT)	Software Tool in Excel/VBA	DHS Policy Office; USCG	Formerly Debra Elkins; Joe Direnzo	Transition-Ready

3. Education Programs

	CREATE PROJECT-FUNDED AND OTHER (VOLUNTEER/INTERN) STUDENTS								
	Last Name	**First Name**	**University**	**School**	**Department**	**Degree**	**Research Area**	**CREATE Funded?**	**Graduated (Year)**
1.	Prager	Fynnwin	USC	Price	Public Policy	Post-doc	Env. Econ; Nat Hazards/ Terrorism	Yes	2014
2.	Chen	Zhenhua	George Mason	Public Policy	Public Policy	Post-doc	Reg Science; Transportation	Yes	2015
3.	Warren	Eric	USC	Price	Public Policy	MPP		Yes	2015
4.	Shears	Brett	USC	Price	Public Policy	MPP		Yes	2015
5.	Banks	Joshua	USC	Price	Public Policy	MPP		Yes	2016
6.	Miller	Noah	USC	Price	Public Policy	MPP		Yes	2016

CREATE Related Courses, Certificates and Degree Programs Developed				
	Instructor	**University**	**New or Modified**	**Course Title**
1.	Adam Rose	USC	Modified	Economic Impact Analysis

CREATE Related Awards and Recognition				
	Name (Who or What)	**Award/Recognition**	**Date**	**Other Details**
1.	A. Rose Team	CREATE Transition Product of the Year	June 2015	Nominee for DHS OUP Transition Product of the Year

4. Outreach Programs

Membership in Major DHS-Related Committees		
Name and Committee	**Institution**	**Time Period**
Adam Rose, Scientific Advisory Board Panel on Economy-Wide Impacts	EPA	2015-16

Requests for Assistance		
Requester Name and Agency/Institution	**Brief (2-3 sentence) Description of Assistance Provided**	**Dates / Time Period**
James King, Terrorism Risk Assessment Working Group/ DHS S&T	Advice on econ consequence analysis (including 2 webinar presentations	7 to 12/ 2014
Steve Cauffman and Robert Chapman, NIST	Advice on economic resilience component to new Community Resilience Center	Begun 2/2015
Tony Cheesebrough, NPPD	Advice on Economic Analysis	Begun 7/2014
Erica Seville, Economics of Resilient Infrastructure Program, New Zealand	Advice on research and implementation strategies	Begun 10/2014

5. Project Performance Metrics

Follow-on Funding from Other Sources (Other than OUP)

Follow-on Funding from Other Sources (Other than OUP)			
Funding Name and Agency/Institution	**Project Title**	**Amount**	**Dates / Fiscal Year**
From DHS:			
CIRI COE	Measuring Economic Resilience	$250K	10/1/16 to 9/30/16
From Other Federal, State and Local Governments:			
NSF	Dynamic Economic Resilience	$497K	7/15/14 to 7/15/16

Table 1: FY2015 Project Performance Metrics

Categories of Accomplishments – Number of:	FY2015 (Year 11)
Student Enrollment in COE Programs:	
Traditional undergraduate and graduate students attending classes	4
Students registered in on-line or other distance learning courses	
Homeland security professionals attending courses	
Project-Funded Students	6
Papers (*plus 5 reports*)	11
Software Products Developed	1
New Courses Developed (*Modified*)	1
New Certificates or Degree Programs Developed:	
New Degree Programs	
New Certificates	
New private or public licensees/partners using coursework licensed by the COE	
Patent Applications	
Patents Awarded	
Requests for assistance or advice from DHS (# of different DHS contacts/projects/requests)	1
Requests for assistance or advice from Federal, State, Local Government	3
Follow-on funding from other sources (*NSF and new CIRI COE*)	$747K
Presentations	16
Congressional Testimonies	
Projects Completed	3