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Economic Impacts of Spillover Effects of Terrorism Countermeasures at Public Assembly Sites

Abstract: In recent years, there have been many high-profile attacks on large, relatively unprotected venues, including entertainment and shopping complexes in the U.S. and around the world. Public and private decision-makers can choose from a wide array of terrorism countermeasures. A question arises as to whether patrons' complaints about delays, inconvenience and invasion of privacy actually translate into decisions to attend fewer such events. This paper presents the

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bottom-line economic impacts of terrorism countermeasures on business revenue at three public assembly venues and on their surrounding regional economic activity. These venues include an MLB Stadium, an NBA/NHL Arena, and a Convention Center. The analysis is based primarily on survey responses relating to changes in attendance that stem from public perception of the implementation of four major types of countermeasures. The surveys indicated that the majority of patrons were not affected either way by the presence of the countermeasures, but nearly all of the remainder felt more secure in the presence of the countermeasures to both terrorism and ordinary crime, which resulted in an increased likelihood of attendance. The economic impact estimates yield a small but notable positive impact on business revenues, though this outcome varies significantly across venue types.

Keywords: terrorism countermeasures, economic impacts, spillover effects, public assembly sites, consumer behavior

1 Introduction

In recent years, there have been many high-profile attacks on large, relatively unprotected venues, including entertainment and shopping complexes in the U.S. and around the world. Such events often take the form of shootings, explosive detonations, or vehicle attacks. Several major attacks on entertainment venues have taken place since 2015 around the world. On November 13, 2015, eight co-ordinated terrorist attacks took place in Paris, including three suicide bombers firing upon patrons and taking hostages during a rock concert attended by more than 1,500 people, with 90 people killed and over 200 others injured. In the suicide bombing attack at the Manchester Arena following a concert in 2017, 22 people were killed and another 119 were injured. The deadliest attack committed by an individual at entertainment venues in the U.S. was the 2017 Las Vegas shooting. The assailant opened fire from a nearby hotel room at the crowd attending a concert killing 59 people and wounding 850. Another mass shooting in a nightclub in Orlando, Florida in 2016 took the lives of 49 people and injured another 53 (START 2021).

Since 2005, 485 terrorist attacks occurred in the U.S. Although only six of them occurred in large entertainment venues, they represent the deadliest incidents, which account for 30% of total number of deaths and 50% of the number of injured. The average numbers of death and injured are 0.8 and 3.9 across all incidents, while these numbers are 24.2 and 187.6 for the incidents that occurred in entertainment venues (START 2021).

These deadly attacks highlight the need for proprietors and owners to reduce the vulnerability of such targets to assault by terrorists and criminal actors. Public and private decision-makers can choose from a wide array of terrorism countermeasures, such as metal detectors, bag checks, security personnel, and closed-circuit television (CCTV) cameras. While waiting in line to enter public venues such as a baseball stadium, basketball arena or convention center, it is not unusual to hear people complain about the delays, inconvenience, and invasion of privacy associated with these various screening processes. A question arises as to whether these complaints actually translate into decisions to attend fewer such events. This possibility may cause owners and managers of these venues to be less inclined to implement countermeasures, thereby increasing the terrorism risk. It is in policy-makers' and proprietors' best interests to understand how such security solutions might positively or negatively impact venue attendance.

This paper presents the bottom-line economic impacts of terrorism countermeasures on business revenue at three public assembly venues and on their surrounding regional economic activity. The analysis is based primarily on survey responses relating to changes in attendance that stem from the implementation of the various countermeasures.

The objective of implementing terrorism countermeasures is to reduce the potential of a terrorist event. However, we investigate the economic impacts of two sets of "spillover effects". Negative spillovers refer to the possibility that the countermeasures will decrease attendance as a result of delays and invasion of privacy. Positive spillovers stem from the fact that people feel safer, not only with regard to terrorism, but also to ordinary crime.

We build on previous literature in this area. Economic impact analysis of public assembly sites, such as stadiums and convention centers, has been prevalent in the literature for many years. However, the examination of counterterrorism spillover effects is rather new. We build primarily on the study by Rose, Avetisyan, and Chatterjee (2014), which estimated the economic impacts of both positive and negative spillover effects of terrorism countermeasures in midtown Manhattan. However, that study was not based on results for any specific sites, nor did it include any public assembly venues, in contrast to the current study.

Therefore, this paper represents the first study to evaluate the economic impacts of spillover effects of terrorism countermeasures on patron attendance at public assembly sites and does so on the basis of primary data. It provides a methodology for performing studies not only for public assembly venues but also

other types of soft-target sites,[1] such as shopping malls, hotels, and office buildings.

Our survey results indicated that the presence of newly installed or enhanced countermeasures had a net positive impact on patron attendance. Even our lower-bound (conservative) estimates indicate a range of an 11.7–42.8% increase in the likelihood of attendance for patrons living inside the metropolitan area in which the venue is located and between 8.4% and 60% for patrons from outside the host region. These changes in attendance led to a $7.9 million to $59.4 million increase in ticket revenues. Moreover, the increases in ticket prices and associated patron spending off-site resulted in an increase in regional GDP of as much as $462 million and more than 6,100 job-years of employment in the case of the Metropolitan Area Convention Center.

Note that our analysis involves some critical assumptions, and therefore we performed sensitivity tests. The main results presented first are for a lower-bound estimate in order to be on the conservative side. The outcome of the sensitivity tests, however, confirms that our results are robust.

2 Conceptual Framework

In evaluating the implementation of terrorism countermeasures, decisions are often based on benefit-cost analyses (BCA) by public policy-makers or on private profitability assessments by businesses. The former typically involves probability-adjusted estimates of benefits or avoided losses (measured in GDP, or economic welfare, mortality and morbidity) due to a terrorist attack juxtaposed to the cost of implementing the countermeasure. Private sector calculations are typically based on considerations of cost juxtaposed to changes in revenues. However, business decisions are a bit more complicated on both the cost and revenue sides. Businesses are concerned about public safety, but mainly in terms of effects on their liability, and their implementation of countermeasures is often intended to demonstrate due diligence in protecting their patrons to avoid lawsuits. Another factor is the extent to which countermeasures would affect attendance and hence revenues for reasons other than promoting safety. The patrons' behavioral

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1 The U.S. Department of Homeland Security (2018) has established official designations of soft-target terrorism sites defined as "locations that are easily accessible to large numbers of people and that have limited security or protective measures in place making them vulnerable to attack." This includes eight commercial facility sub-sectors: Entertainment and Media, Gaming, Lodging, Outdoor Events, Public Assembly, Real Estate, Retail, and Sports Leagues. Note also that "Public Assembly" sites are sometimes referred to as "Public Gatherings".

response to countermeasures could be positive if it makes them feel safer or negative if it is viewed as an invasion of privacy or imposition on their time, both of which are often associated with various screening devices.

Anecdotal evidence from listening to complaints by those waiting in line at events in soft-target venues indicates the possibility of terrorism countermeasures having a significant negative effect on patron attendance. We refer to this potential response, or its positive effect counterpart whereby countermeasures make people feel safer and thus increase attendance, as "spillover effects" of the implementation of the countermeasure, because it does not bear directly on the cost of implementation, liability concerns of business owners of public venues or on the avoidance of death and injury losses prevented.

This paper focuses on spillover effects and their numerical estimation in terms of direct impacts on business revenues and indirect impacts on economic activity in the surrounding region. This is of obvious interest to businesses, but also to government officials concerned about the economic health of their jurisdictions.[2] The paper represents the first study to evaluate the economic impacts of spillover effects of terrorism countermeasures on specific sites with the use of primary data. We did not perform a complete benefit-cost analysis because our research is not intended as a comprehensive case study, but rather a focused examination of countermeasures' spillover effect, its delineation, and various aspects of its estimation.

In performing the study, we use a straightforward profitability analysis for individual businesses and input–output analysis to estimate regional economic impacts. These methods are discussed in more detail below and in the following sections.

Protection Motivation Theory (PMT) was proposed by Rogers (1975) and revised by Maddux and Rogers (1983) as a framework for understanding fear appeals in persuasive communication. Lindell and colleagues have proposed the Protective Action Decision Model (PADM), an extension of PMT, to capture public behavior related to environmental hazards and disasters (Lindell and Hwang 2008; Lindell and Perry 2012). Yet another extension of PMT has been proposed, Secondary Risk Theory, to account for public perceptions and behavior related to vaccination (Cummings, Rosenthal, and Kong 2021).

Spillover effects related to increased deployment of counterterrorism measures at a facility will depend on whether patrons increase or decrease their

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2 Many soft-target sites have both private and public aspects, as when the stadium is owned by a local government but is leased to a private sports team. Another decision-maker in the mix is a sports league or professional association connected with the site that has its own concerns and requirements. All of these decision-makers can benefit from methods and findings of this study.

attendance behavior at the facility. PMT provides a broad framework for understanding cognitive processes that lead to either increased or decreased attendance as a function of the level of counterterrorism measure deployment. PMT posits that behavioral intentions (to attend) are contingent on protection motivation, i.e., motivation to protect against the threat of terrorism or crime at a public venue. PMT further posits that such protection motivations are determined by cognitive appraisals of the threat posed and the mitigation (or coping) provided. Threat appraisals are determined by perceptions of the severity and susceptibility of the threat, whereas coping appraisals consist of perceptions of both self-efficacy and response efficacy.

A key aspect of the study is data on attendance in the absence and presence of terrorism countermeasures. There are generally two approaches to the collection and use of such data. The first is revealed preference, or data based on people's observed behavior. This would typically be in the form of aggregated data on attendance before and after the countermeasure was implemented. However, the statistical estimation of changes in attendance at a sports stadium would need to control for team performance, fan allegiance, ticket and related prices, and measures of the terrorist threat. An alternative approach is stated preference, which uses surveys to obtain responses to direct questions about attending events at the venue before and after countermeasure implementation. Note that in the background are some of the same conditions affecting the decision noted above, but the survey approach assumes that the respondent is able to sort these out and separate them from the direct answer to the question.

Survey questions were designed to elicit information related to the key elements of threat and efficacy within the PMT framework, including:

– Awareness of countermeasures
– Perceived effectiveness of countermeasures
– Negative attitudes towards countermeasures
– Effect of countermeasures on future attendance
– Perceived vulnerability of the venue
– Value placed on security

Survey methods have been used extensively for understanding public perceptions of threats from environmental disasters and terrorism, efficacy of risk mitigation strategies, and trade-offs among conflicting objectives related to risk mitigation. The survey paradigm employed has been used successfully to obtain self-reports of perceptions and attitudes related to mitigating terrorism risk in a variety of domains, including soft-target terror attacks (Baucum et al. 2018, 2021; Cui, Rosoff, and John 2016), personal cybersecurity threats (Kusumastuti, Rosoff, and John 2019; Nguyen, Rosoff, and John 2016, 2017a; Rosoff, Cui, and John 2013a; Rosoff

et al. 2013b), airport security checkpoints (Nguyen, Rosoff, and John 2017b), biological terrorism, including flu pandemics (Rosoff, John, and Prager 2012), and anthrax attacks (Rosoff, Cui, and John 2013a; Rosoff et al. 2013b).

Spillover effects are an important potential aspect of decisions on implementing technologies or policies beyond the context presented here. They could arise in relation to screening associated with preventing the spread of COVID-19 or other health threats at soft-target sites, as well as at factories in terms of impositions on workers and retail outlets in terms of impositions on customers.

The estimation of spillover effects is an important component of an overall private profitability or benefit-cost analysis. Large spillover effects negatively affecting profits might undercut the optimal implementation of countermeasures. Public decision-makers could find it useful to consider such calculations (adjusted for substitution of spending on other activities) in a BCA for a given jurisdiction. Government decision-makers need also consider the position of the individual businesses in terms of negative spillover effects to guard against or pushback on implementing technologies and policies to improve public safety. The estimation of spillover effects is the first step in both the private and public sectors finding ways to avoid, or at least to reduce, the negative ones, as well as to possibly enhance the positive ones.

Our survey was designed to provide input to the economic spillover analysis. The survey asked patrons of particular public venues to state whether their attendance at the venue would be likely to increase, decrease, or stay the same with greater deployment of security countermeasures, assuming that all other aspects of attending the venue remain fixed. One hypothesis is that patrons find some or all of the countermeasures inconvenient and/or an invasion of privacy, and would indicate that increased use of such countermeasures would decrease their future attendance at the venue. A second hypothesis is that patrons have become accustomed to the ubiquitous use of security countermeasures at public venues, and their increased deployment would have little or no impact on future attendance. A third hypothesis is that patrons are greatly concerned about their safety while attending public venues and would attend more frequently if they felt safer; those who believe that security countermeasures are effective at reducing crime and terror threats would indicate that greater deployment of security countermeasures would increase their attendance at future events. The survey was designed to estimate the percentage of patrons whose future attendance would either decrease, increase, or stay the same following increased deployment of specific security countermeasures. In addition, the survey was also designed to estimate the percent changes in attendance for those who indicated either increases or decreases in future attendance.

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We have used a combination of economic analyses to estimate the impacts of terrorism countermeasures spillover effects. This includes a straightforward analysis of the impacts on business revenues of the soft-target venues based on survey results of how the countermeasures affected attendance. These survey re-sults are based on an assumption that the respondents compared a scenario of increased countermeasure deployment to the status quo where the other condi-tions affecting the decision, such as ticket price, team performance, availability of substitution activities, remain the same. We used the standard modeling approach of input−output analysis to estimate regional impacts, controlling for such complicating factors as substitutions between our soft-target sites and other expenditure opportunities by its patrons and differences in length of stay and spending between local patrons and those coming in from outside the area.

3 Literature Review

3.1 Survey on the Impact of Security on Patron Attendance

Three previous studies asked respondents at sports venues about the impact of security on their enjoyment of events held there. Overall attitudes towards security were neutral, with a minority (approximately 22–24%) saying security enhanced enjoyment and a smaller minority (2–6%) reporting security detracting from enjoyment. Taylor and Toohey (2006) surveyed attendees at the 2003 Rugby World Cup and found 74.3% of respondents said that security had a neutral impact on enjoyment, with 23.8% reporting a positive impact and 1.9% a negative impact. Toohey, Taylor, and Lee (2003) performed a survey during the 2002 Soccer World Cup in Korea and had a similar result. Approximately 70% of respondents reported that their satisfaction of the event was unaffected by the event security, 22% of respondents felt that the security enhanced satisfaction, and 6% stated that event security detracted from enjoyment. Finally, in a survey of spectators during the 2004 Summer Olympic Games in Greece by Taylor and Toohey (2007), spectators rated security as having an overall neutral impact on enjoyment; the overall mean = 2.96 on a five-point scale: negative impact = 1 to positive impact = 5.

Feickert et al. (2006), using survey data, found that U.S. hotel guests were willing to pay an additional 10% for security features that they found acceptable. This survey also found that women, or those respondents in general who were more in favor of overt security measures (armed guards, metal detectors, law enforcement background checks), were more willing to pay for added security features. In comparison, respondents who traveled frequently or were older were less willing to pay for security features. Rittichainuwat and Chakraborty (2009)

surveyed travelers in Thailand and reported that 63% of respondents would not compromise personal safety from terrorist or disease risks in exchange for low travel costs.

Rose, Avetisyan, and Chatterjee (2014) estimated spillover effects on business of two terrorism countermeasures, random vehicle inspections (RVI) and CCTV, using a survey of generalized countermeasures in Manhattan and a macroeconomic model. Results indicate that RVI could result in a 13.4% decrease in business activity due to a combination of delays and inconvenience, equating to an annual direct loss in business revenue of $1.7 billion and total annual (direct plus indirect) GDP loss of $2.9 billion across the greater New York City Metropolitan Area. CCTV was estimated to have a positive net impact, with improvements in the business environment through perceptions of improved safety against both terrorism and ordinary crime outweighing factors like invasion of privacy. For this countermeasure, the analysis projected a 4.16% increase in direct business activity, equating to an annual increase in direct business sales revenue of $545 million and a total GDP increase of $1.1 billion.

3.2 Economic Impact Analysis for Sports Venues and Convention Centers

Many studies have analyzed the economic impacts of tourist expenditures in relation to attendance to sport events and found such injections of spending into the event hosting region can significantly benefit local business and the regional economy as a whole. By collecting expenditure data across eight spending categories for over 250 visitors to the baseball games, Dixon, Henry, and Martinez (2013) found that the total economic impact of a medium-sized university's home games during one baseball season is about a $2.3 billion increase in GDP to the hosting region.

Evans (2018) analyzed the economic and fiscal impacts of the 2018 Cactus League on Arizona. The analysis is conducted based on the spending by out-of-state baseball fans attending one or more games, expenditures by the participating MLB teams, and the operation-related expenditures of the Cactus League ballparks during the Spring Training season. Survey data were collected from 2,490 out-of-state visitors at 25 games hosted in 10 Cactus League ballparks. Direct expenditures by these visitors were estimated to be over $315 million. The MLB organizational expenditures and the operational expenditures of the 10 hosting ballparks were about $27 million and $0.83 million, respectively. All of these direct expenditures result in an increase of $373 million GDP in Arizona and an employment benefit of 6,439 jobs.

CEDR (2018) estimated the direct revenues associated with the operation of the SunTrust Park stadium (renamed to Truist Park in 2020) and the surrounding development directly linked to the stadium in Cobb County, Georgia. The study estimated that about 18% of the baseball game tickets are sold to people from outside of a radius of 2-h drive distance. Based on the assumption of $105 daily spending per visitor by the leisure travelers, these visitors brought about $0.91 million local sales and hotel tax annually to Cobb County. The sale revenues of stadium concession are estimated to be $0.82 million. This study did not analyze the total economic impacts associated with these direct expenditures.

Convention centers are also found to make valuable contributions to local economy. Ortiz (2018) analyzed the economic impacts of the New Orleans Ernest N. Morial Convention Center on the New Orleans metro region. The study collected data on nearly 740 thousand out-of-town visitors that attended in 134 events held in the Convention Center in 2017. Direct spending of both exhibiting companies and visitors (including registered delegates, exhibitors/officials, and their spouses/guests) are first estimated. The GDP and employment impacts are estimated to be $2.3 billion and 22,690 jobs, respectively.

Two studies were conducted to evaluate the economic and fiscal impacts stemming from the expansion of the Broward County Convention Center in Florida and the Wisconsin Center, respectively (HVS 2014, 2019). In both studies, future increase of event demand associated with the expansion was first projected. The studies next estimated the spending by daytrip and overnight visitors and exhibitors/organizers. Only spending by non-resident visitors is included as stimulus to local economy. HVS (2014) found that the expansion of the Broward County Convention Center could result in an $1.1 billion increase in GDP over a 20-year period and generate over $1.2 million per year. For the Wisconsin Center, the annual GDP impacts are estimated to be $0.35 billion (HVS 2019).

In all these studies reviewed, the I–O analysis approach, to be discussed in more detail below and in Appendix A, was applied to analyze the economy-wide impacts of increased expenditures by the leisure travelers to the sports or convention center events. All studies have adopted the assumption that only expenditures from non-local residents represent additive stimulus to the host region and are thus able to generate benefits to the local economy.

4 Survey Methodology

This paper describes in detail the survey methodology employed. As this paper focuses on estimating the economic spillover effects of security countermeasures, our description of the survey questions and results is limited to those questions

directly bearing on spillover effects. Hence, we focus only on questions that address the extent to which deployment of additional countermeasures would either increase or decrease future attendance at the three specific public venues studied.

4.1 Site Selection

The U.S. Department of Homeland Security has identified commercial facilities as one of 16 critical infrastructure sectors (DHS 2020). DHS has further specified eight sub-sectors of the commercial facilities sector as critical infrastructure: entertainment and media, gaming, lodging, outdoor events, public assembly, real estate, retail, and sports leagues. Our study of countermeasures against terrorism focuses on one of those sub-sectors, public assembly (e.g., arenas, stadiums, aquariums, zoos, museums, convention centers).

We sought to identify a representative sample of venues spanning the public assembly sub-sector of commercial facilities and distributed geographically across the U.S. More than two dozen sites were chosen as preliminary candidates, but the list was narrowed for several reasons. For example, office buildings were eliminated at the outset because we believe that business transactions would not be influenced significantly by any positive or negative spillover effects. We also judged that hotels would not be affected, either positively or negatively. Other types of venues were not included because of their inability to meet the criteria below and for lack of willing partners. With the help of DHS Protective Security Advisors (PSAs) and the Business Executives for National Security (BENS) organization, we partnered with three sites. Because of confidentiality concerns, however, we are not able to reveal venue identities but note that they represent:

–   Stadium that hosts a Major League Baseball team
–   Arena that hosts both National Basketball Association and National Hockey League teams
–   Metropolitan Area Convention Center that hosts a broad range of events

We invoked the following criteria in our selection process to ensure that the venues utilized a variety of countermeasures and that they were installed or upgraded within recent years, so that they would likely be salient to customers of the venue:

–   Sites with at least three distinct types of countermeasures or configurations of countermeasures in place, either visible or hidden, and preferably at least one of each

- Sites for which at least three countermeasures or configurations of counter-measures were newly installed or upgraded in the last three years
- Sites that are not too unique in terms of type of facility, vulnerability, geographic location, etc.
- Sites that represent a diversity of commercial categories, sizes, geographical locations, and racial/ethnic group patrons

Based on extensive structured interviews conducted with management personnel at the three selected venues, we identified four security measures currently used at all three venues:

1. Closed-circuit television (CCTV) cameras
2. Uniformed and undercover security patrols (with dogs)
3. Metal detectors at entry checkpoints
4. Bag inspection at entry checkpoints

4.2 Survey

Surveys were designed to assess knowledge, beliefs, attitudes, and behavioral intentions related to several public assembly countermeasures in three specific venues in urban areas. Each reference survey included various categories of questions aimed at understanding customers' awareness of the four identified security measures, their attitudes towards their effectiveness, and the potential impact of such security measures on customer attitudes and attendance. The items included in each survey can broadly be categorized under the following topics:

- Awareness of countermeasures
- Perceived effectiveness of countermeasures
- Negative attitudes towards countermeasures
- Effect of countermeasures on future attendance
- Perceived vulnerability of the venue
- Value placed on security

Data were collected in three separate surveys targeting customers and potential customers at each venue. All data were collected using a Qualtrics Panel, a widely accepted source of online participants for behavioral research. Respondents in all three surveys were compensated for their participation. In all surveys, respondents were eliminated for failing any one of four quality check questions. Respondents for each survey were screened to exclude those who in the recent past (approxi-mately three years) had never attended an event at the venue, had never

considered attending an event at the venue, and had no intention of possibly attending an event at the venue in the future. We specifically included those who had never attended an event at the venue, but who had considered attending an event at the venue in the past or would consider attending an event at the venue in the future. This inclusion criteria mitigate the problem of underestimating concerns about security due to selection bias resulting from sampling only customers who are willing to attend the venue with the current security measures in place. A quota sample of a little over 400 adult respondents was obtained for each venue, stratified by sex and age jointly. This stratification was used to obtain adequate representation of customers by age and sex and not to match the customer base for each venue, which was not available. For each survey, we obtained approximately equal size groups of men and women in each of six age categories: 18–25, 26–35, 36–45, 46–55, 56–65, and over 65 years of age.

The survey questions pertinent to the spillover effects of countermeasures ask respondents whether they would be more or less likely to attend events at the public gathering venue in light of specific terrorism countermeasures. Most of the questions ask for specificity in terms of percentage changes in attendance. For a detailed analysis of the surveys and responses, the reader is referred to John et al. (2020).

As an example, following are the questions related to patrons' attitudes toward video cameras in relation to their likelihood of attending the Metropolitan Area Convention Center.

Q1. Since the venue increased its use **of video cameras** for surveillance, has that affected your likelihood of attending the Metropolitan Area Convention Center?

– Decreased my likelihood of attending
– No change in my likelihood of attending
– Increased my likelihood of attending

For those who chose "Increased my likelihood of attending" in Q1, they were next asked:

Q2. Since the venue increased its use of **video cameras** for surveillance, how much has it increased your likelihood of attending the Metropolitan Area Convention Center?

> For example, if you would have attended three events but now you would attend six events, that is an increase of 100%.

– Increased my likelihood of attending by up to 100%
– Increased my likelihood of attending by more than 100%

For those who chose "Decreased my likelihood of attending" in Q1, they were next asked:

Q3. Since the venue increased their use of **video cameras** for surveillance, what percent has your likelihood of attending the Metropolitan Area Convention Center decreased by?

> For example, if you would have attended four events but now you would only attend 2, that is a decrease of 50%.

	−100	−90	−80	−70	−60	−50	−40	−30	−20	−10	0
Likelihood of attending (%) ()											

For those who chose "Increased my likelihood of attending by up to 100%" in Q2, they were next asked:

Q4. Since the venue increased its use of **video cameras** for surveillance, what percent has your likelihood of attending Metropolitan Area Convention Center increased by?

> For example, if you would have attended four events but now you would attend 6, that is an increase of 50%.

	0	10	20	30	40	50	60	70	80	90	100
Likelihood of attending (%) ()											

For those who chose "Increased my likelihood of attending by more than 100%" in Q2, they were next asked:

Q5. Since the venue increased its use of **video cameras** for surveillance, what percent has your likelihood of attending Metropolitan Area Convention Center increased by?
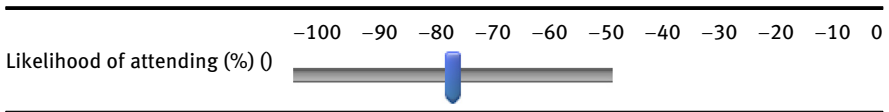
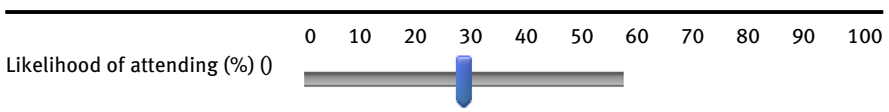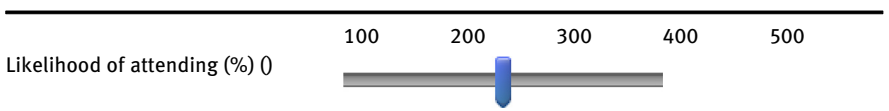> For example, if you would have attended four events but now you would attend 12, that is an increase of 200%.

	100	200	300	400	500
Likelihood of attending (%) ()					

Qualtrics was selected to recruit participants and administer the survey in an online format. With wide-spread internet accessibility, online surveys are generally preferred to telephone or in person surveys due to their anonymous nature (detailed descriptions about Qualtrics panel services can be found at the (Qualtrics 2021). Qualtrics provided separate quota samples stratified by age and sex based on U.S. census data for each of the three public venues selected. Prior to launching the survey, extensive pilot testing was carried out to assure that questions were easily understood and to estimate the time required to complete the survey. A total of four attention check questions were included throughout the survey to identify respondents who were not reading the questions carefully or who were responding carelessly, which is a standard practice for online surveys. Sample sizes for each venue were determined from a power analysis. A sample size of $N = 400$ insures that estimates of population percentages will have a standard error (SE) less than 2.5% (for example, a true population percentage of 20% or 80% would have a SE = 2%).

Note that, overall for the three public assembly venues sampled, 72% of the respondents stated that terrorism countermeasures had no effect on their attendance, 25% stated that the countermeasures increased their likelihood of attendance, and only 3% stated that the countermeasures decreased the likelihood.

5 Survey and Other Data Related to Changes in Attendance

Table 1 presents the survey results on the changes in the likelihood of attending each venue after implementation of the four countermeasures for patrons of the four venue/event types. These data were obtained through the specific venue surveys described in John et al. (2020). The percentage changes in Table 1 represent lower-bound estimates. A detailed explanation of alternative key assumptions adopted (including the results of upper-bound estimates) is presented in Section 6.

Table 1: Changes in likelihood of attendance at four venue/event types (lower-bound estimates).

Venue	Attendees from the MSA	Attendees from outside of the MSA
MLB (193/93)	23.8%	20.8%
NBA (126/13)	41.2%	45.8%
NHL (130/23)	11.7%	8.4%
MACC (153/52)	42.8%	60.0%

Sample sizes for attendees inside and outside the Metro Area are presented in the parentheses following the venue titles (the first number is for within the Metro Area and the second number is for outside of the Metro Area).

For each respondent, there is a possibility of both positive (enhanced security) and negative effects (invasion of privacy and delay) of the increased use of countermeasures that influence their decision on attendance. For those who indicated an increased likelihood of attending, the positive effects exceed the negative ones. On the other hand, for those who indicated a decreased likelihood of attending, the negative effects exceed the positive effects. The survey results reveal the net effect of the positive and negative effects on customers' decisions. The survey results on a qualitative question about attendance indicate that for all four venue/event types, the "more likely attending" response overwhelmed the "less likely attending" response (i.e., the positive "net effect" overwhelmed the negative "net effect"), though a sizable majority for all four venue/event types indicated the presence of countermeasures had no effect on their attendance. The results are evenly split in terms of people residing within the metro area indicating a higher or lower percentage increase in likelihood of attending than visitors from outside of the metro area. Interestingly, note that the NBA and NHL games in the same venue fall on either side of this question. Also, we note that people visiting the Metropolitan Area Convention Center are more likely to increase their visits to the venues after the increased use of countermeasures because a higher proportion of convention center visitors typically reside elsewhere than for sporting events, and patrons are more concerned with security in a geographic area with which they are unfamiliar.

The second column of Table 2 presents a range of total number of annual attendees for the four selected venue/event types in the most recent year that data are available. We only provided a range for attendance so as not to divulge the identity of the venue. The last two columns of Table 2 present the average ticket price based on the survey results. The ticket price for each venue represents an average of the ticket prices reported by the survey respondents. This represents an average of a combination of regular tickets for admission only and possible

Table 2: Total annual attendance and average typical ticket price by venue.

Venue	Attendance[a]	Average ticket price (2016–2019)[b]	
		Attendees inside metro	**Attendees outside metro**
MLB	2.5–3.0 million	$51.61	$51.45
NBA	0.5–1.0 million	$76.71	$91.92
NHL	0.5–1.0 million	$89.46	$94.13
MACC	2.0–2.5 million	$48.59	$58.08

[a]Attendance range is for CY 2019 for MLB and MACC and for FY 2019 for NBA/NHL. [b]Sample sizes for attendees inside and outside the Metro are the same as in Table 1.

premium tickets. The latter may also include amenities such as parking, complimentary food, and other sales that come with the ticket. The survey results do not enable us to separate the estimates of the amenities expenses from the admission price. However, since all of these represent ticket sales to the venues, we will use these average ticket price data to translate changes in attendance into changes in venues ticket sale revenues in the next section.

6 Impacts on Business Sales Revenue

Table 3 summarizes the lower-bound estimates based on the survey results on changes in the likelihood of attendance at the venues motivated by the implementation of the terrorism countermeasures. These results are multiplied by the survey results on average ticket prices to arrive at changes in ticket sales revenue for our best estimate, which we have designated as a "lower-bound". The venue for which the existence of countermeasures has the likely greatest effect on ticket sales revenue is the Metro Area Convention Center (MACC), despite its low average ticket prices relative to the other venues. The major factor influencing this result is that this venue has the highest proportion of respondents indicating that countermeasures have had an increased effect on their attendance. At the other end of the range is the NHL team at the Sports Arena, despite having the highest ticket prices of any venue.

One thing to note again is that, although several factors (changes in ticket prices, team success, and availability of alternative or substitution options) can affect people's decision of attendance, an implicit assumption of the survey design

Table 3: Changes in attendance and ticket sales due to the implementation of countermeasures – lower-bound estimate.

Venue	Attendees from the MSA			Attendees from outside the MSA			Total Changes in ticket sales (10^6 2018\$)
	Change in attendance		Change in ticket sales (10^6 2018\$)	Change in attendance		Change in ticket sales (10^6 2018\$)	
	Percent	Amount (10^3)		Percent	Amount (10^3)		
MLB	23.8%	482	24.9	20.8%	201	10.3	35.2
NBA	41.2%	242	18.5	45.8%	41	3.8	22.3
NHL	11.7%	79	7.1	8.4%	9	0.8	7.9
MACC	42.8%	704	34.2	60.0%	434	25.2	59.4

Sample sizes for attendees inside and outside the Metro Area are the same as in Table 1.

is that the respondents answer the question with the understanding that all other factors are held constant (i.e., with no presence of other stimuli), and the only change in the situation is the increased deployment of the countermeasures. In other words, when the respondents report their likely reactions to the enhanced security measures, the results also reflect the baseline level of elasticities of substitution of patrons attending games in different leagues and sports. Many studies have analyzed the existence of fan competition at different levels (such as within and across major sports leagues) and identified major factors affecting these behaviors. Henrickson (2012) applied a spatial autoregressive model to analyze the attendance and pricing data for the four professional sports leagues in the U.S. (MLB, MBA, NFL, and NHL) for 10 years between 1995 and 2005. The results indicated significant fan substitutions between professional teams within the major leagues, with ticket pricing, fan loyalty, and team performance being the significant influencing factors. Other studies found similar substitutions between different levels of games within the same sport types. Gitter and Rhoads (2010) found that, when the ticket prices of MLB games increase, baseball fans increase their attendance at minor league games if they are held within 100 miles. Using data on border passenger car crossings into the U.S. from Canada, Mills et al. (2014) found significant increases in crossings on days of home games of the NFL's Buffalo Bills, representing about 5–8% of the total attendance of the game. In addition, the study provides evidence of a price effect in the competition between home games of Buffalo Bills and sports games held in Toronto of other major North American leagues (including MLB, NHL, and NBA). However, this differs from Mills and Rosentraub (2014), who found evidence of influence of quality and performance of teams for within-league competition, though, this effect is not significant for competition across leagues and sports (Mills et al. 2014). Using MLB television broadcast viewership data, Mills, Mondello, and Tainsky (2016) evaluated the cross-quality elasticity of competition in local shared market. Although as expected, relative quality of teams influences fan competitions when there are large disparities in quality, an interesting increased attendance beyond own-team performance effect was observed when both teams play with high quality, indicating complementary effects in a shared market. In addition to substitutions between sports events, given the constraints of budget and time, people also substitute between sports events and other leisure activities. For example, Sanchez, Elliott, and Simmons (2016) analyzed the effects of mega sports events on cinema attendance and box office revenues in a quasi-natural experimental setting and found clear substitutions in people's choice among leisure activities. The lower percentage change in attendance for NHL patrons observed in Table 3 might be explained by their stronger team allegiances, and are thus less elastic to changes in other factors.

7 Regional Economic Impacts

A number of regional economic impact analysis models were available to us, including state-of-the-art computable general equilibrium (CGE) analysis. This modeling approach was used in Rose, Avetisyan, and Chatterjee (2014) because that study included an examination of the benefits of the countermeasures in terms of reducing the economic consequences of major types of terrorist attacks, which potentially have huge impacts on economic activity. CGE is needed when economic impacts are large and are likely to strain the resource base, resulting in major types of substitutions and price increases (Rose 1995). This is not the case for examining only the effects of attendance at sports complexes and convention centers. Therefore, we've chosen to adopt an input–output (I–O) analysis approach, the most commonly used tool of regional economic impact studies in general and a mainstay of most sports impact studies to date. In our case, the impacts examined will be even lower than the standard general operating impacts because we are simply measuring changes. Thus, I–O analysis is appropriate to the task and also more transparent than is CGE analysis.

The general literature on regional economic impacts of public assembly sites such as sports/entertainment/recreational facilities has gone through an important evolution, but it is still controversial. Much of the controversy stems from the general concerns in the benefit-cost analysis literature about new projects for expansion of existing ones, including that: expansion – when full employment is present – simply displaces other activities, consumer spending on one activity within the region in question simply displaces other spending there, much of the revenues are likely to go to "absentee" owners, and the multiplier general equilibrium effects are often exaggerated (see, e.g., OMB 2003; Boardman et al. 2011). More recently, however, there have been analyses or guidelines that are more positive about the worthiness of the direct and indirect effects of such activities (see, e.g., Farrow and Rose 2018), calling attention to considerations such as the fact that full employment is often not present, and, even if it were, geographic labor mobility overcomes the obstacle.[3]

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3 The geography of the issue comes into play in a couple of ways and is controversial as well. For example, should the well-being of the in-migrants taking the new positions count, should the well-being of those visiting the region to partake in activities count, and are not all of these effects simply a transfer within a broader region or the nation as a whole? In our assessment, implicitly the well-being of workers moving into the region would count, the well-being of visitors would not, and the region itself is a worthy area of analysis, separate from other regions and the nation as a whole.

Earlier studies of the impacts of sports and entertainment facilities were biased toward showing large impacts to justify their construction or the offer of tax breaks to retain their tenants. The source of this bias was primarily inclusion of the spending by all attendees at these venues (area residents or otherwise) and other expenditures incurred in the host region as part of the regional economic impacts. However, those living within the host region are likely to apply some or all of their intended spending at the site in question elsewhere within the region if they do not attend the sports/entertainment events. For example, those who increased their attendance and spending at sports events may simply reduce their expenditures in other entertainment and leisure activities in the metropolitan regions, such as going to movie theatres, concerts, museums, etc., hence, there is, for the most part, only a substitution effect of economic activities within the region, rather than any direct stimulus (see, e.g., CEDR 2018). The stimulus would arise from the attraction of fans from outside the region, who add to its economic base. For those out-of-region venue visitors, we can reasonably assume that the substitution effects of their increased attendance at the studied venues (e.g., reduced expenditures on other leisure activities) occur mostly in their home regions, and hence those off-setting effects are not included in the analysis of economic impact on the venue region.

We have invoked a similar substitution effect assumption in our analysis.[4] Thus, a key aspect of the analysis is to distinguish the home location of spectators/customers. This is facilitated by the fact that one of the questions in the survey asks for ZIP Code information. For our purposes, we define the host region as the Metropolitan Area surrounding the site and consider anyone coming from outside it as providing a spending injection, and we use the I–O model of the Metro region to estimate the total (or multiplier) effects of the direct spending.[5] We have also decided to use the number of respondents to our Customer Survey that reside within the MSA versus those with a place of residence outside of the MSA to

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4 Note that this represents a conservative estimate, and moves us toward a lower-bound impact. For example, if a sports arena is not available within the region, rabid fans may travel outside the region to watch games, or they may save some of what they intended to spend. Other stimuli are also factored into more general sports venue impact studies, but are not likely to be affected by changes in attendance related to terrorism countermeasures in any significant way. This includes television/radio revenues, which stimulate the local economy to the extent that owners are in-region residents. This applies also to property value increases, including agglomeration effects such as entertainment zones, attributable to the facility. Changes in attendance also affect tax revenues from lodging, restaurants, and on-site concessions, but this is basically another example of the substitution effect of spending.
5 The Metro region where each public assembly site is located is defined as the formal Metropolitan Statistical Area (MSA), delineated by the U.S. Office of Management and Budget.

approximate the percentage of attendees that are local versus non-local for each venue. Using this approach, it is estimated that 32.4%, 13.3%, and 30.5% of the patrons to the MLB Stadium, NHL/NBA Arena, and MACC, respectively, reside outside of the MSA region.

7.1 Methodological Overview

Our analysis consists of the following steps:

1. Compile background data on venue attendance, ticket prices, concession sales, and spending vectors (distinguish between in-region and out-of-region visitors).
2. Compile data from the surveys on percentage changes in attendance relating to each countermeasure and each type of direct spillover effect. Translate the percentage changes into change levels, based on five-year average attendance (we used a smaller number of years for one of our sites due to its recent construction).
3. Match spending categories with I−O model sector classifications (at three-digit NAICS level as presented in Appendix Table B1), and inject the spending into the I−O model as a positive or negative direct change in Final Demand for each countermeasure/spillover effects/venue combination.
4. Run the I−O models.
5. Sum all of the positive and negative individual direct and spillover regional economic impact combinations in absolute and percentage terms to obtain the regional economic impacts.
6. Perform sensitivity tests.

7.2 Data on Spending Vectors

7.2.1 Professional Baseball

Our spending vector was adapted primarily from a survey of baseball spectators attending events in the Atlanta SunTrust Park (CEDR 2018).[6] The expenditures are distributed into six aggregated spending categories (Accommodations, Restaurants, Retail, Entertainment/Recreation, Transportation and Other). The study assumes that, on average, the non-local visitors will spend one day of their trip visiting the SunTrust Park. One thing to note in the spending vectors is that

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6 We note that Atlanta Sun Trust Park was not one of the venues surveyed in the study.

transportation spending only pertains to local transportation because none of the relevant studies in the literature consider en-route spending, such as airfares, as a stimulus to the host region.

The average number of days the baseball game attendees spend per trip varies from one to four days:

– A study for the Atlanta Braves baseball stadium noted that many out-of-town visitors are in the area primarily for other purposes, and that one day of their trip is baseball-related (CEDR 2018).

– Evans (2018) found that the median number of travel days for baseball Spring Training is four, but Spring Training trips may be longer than trips during the regular season.

– Dixon, Henry, and Martinez (2013) found that out-of-town visitors at university baseball games tended to spend one day in the local area, while weekend visitors tended to spend three days.

In this study, we assume that, on average, attendees of the MLB games from outside of the MSA spend 1.67 days in the region (we have given more weight to the estimate reported in the CEDR study because it is the only study pertaining to MLB games in the regular season).

7.2.2 Professional Basketball/Hockey

Our spending vector was adapted from an economic impact study of the proposed Seattle Arena (Pro Forma Advisors LLC 2013). Valuable information includes differentiation in the spending amounts by origin of the visitors (e.g., city or county resident, those from outside of the county, or those from outside of the state). We use the "Outside of County" spending vector for in-state visitors coming from outside of the metro area where the arena venue is located.

A survey of hockey fans (Mohan 2007) asked them what kind of trip they would take to see their team in another city. Forty-six percent of the respondents indicated that they would do two- to three-day trips, and 25% of them indicated that they would do a one-day trip during the weekend with no overnight stay. Based on this survey, we assume that, on average, attendees of the NHL/NBA games from outside of the MSA region stay 1.8 days in the region.

7.2.3 Convention Centers

Our spending vector of convention center visitors was adapted from the literature (HVS 2014, 2019; PCVB 2019; Ortiz 2018). The spending vectors in some of these studies pertain to expenditures per event or trip, in comparison to per-visitor day

expenditures presented in other studies. Unfortunately, the former studies did not provide the data on the average number of days the visitors stayed; however, based on the HVS (2014) study, we estimated that average attendee days are 2.17. This estimate is used to convert all spending vectors to a per-visitor day basis and then to an average spending vector of the convention center.

7.3 Input—Output Modeling

Input–output (I–O) analysis is applied to evaluate the regional and state economic impacts of the spillover effects of terrorism countermeasures implemented at the three selected public assembly sites. I–O analysis, developed by Nobel laureate Wassily Leontief, is the most widely used tool of regional economic impact analysis in the U.S. and throughout the world. It is especially adept at estimating ripple, or multiplier, effects. I–O can be defined as a static, linear model of all purchases and sales between sectors of an economy, based on the technological relationships of production (Rose and Miernyk 1989). An I–O model provides detailed information on the interrelationships between producing sectors in an economy. I–O models also include households as a "consuming" sector, and thus incorporate household spending effects into the multiplier calculation (Miller and Blair 2009).

In an I–O analysis, it is important to distinguish between the two types of second-order effects. The first are "indirect" effects, which represent the interaction between producing sectors. The second type are "induced" effects, which represent the interaction between households and producing sectors; production generates income paid to households, which in turn spend a major portion of this income on produced goods and services, thereby generating additional multiplier effects.

For this study, we use the most widely applied source of regional I–O tables, the Impact Analysis for Planning (IMPLAN) System (IMPLAN 2019). This system consists of three components: 1) a study region (state, county, or sub-county) data base, 2) a set of algorithms capable of generating I–O tables for any state, county, or sub-county group, and 3) a computational capability for calculating multipliers and performing economic impact analyses. The IMPLAN sectoring scheme is currently based on the North American Industrial Classification System (NAICS), and includes the details of 536 sectors (IMPLAN 2016). In this study, we aggregate the 536 sectors into 86 sectors corresponding to the three-digit NAICS codes. The details of the 86 sectors, including their correspondence to the IMPLAN sectors, are presented in John et al. (2020).

I–O modeling has both demand-side and supply-side versions (Miller and Blair 2009). The demand-side I–O model is the standard version, where a change in

final demand affects the economy by causing product supply to respond through a multiplier process. The supply-side I−O model is a variant of the standard model in which the impacts to the economy take place through the production side of the economy. In this study, however, only the demand-side I−O model is applied to analyze how changes in attendance, and thus changes in expenditures by the spectators or convention attendees, result in impacts to successive rounds of supplying sectors in the upstream of the supply-chain. Since the expenditure changes pertain to spending on consumer goods and services, they do not generate any supply-side impacts further down a supply chain.

7.4 Lower-Bound Results

For each of the four venue/event types, the associated patron expenditure vector developed in the previous section is injected into the relevant regional I−O model as a change in the Personal Consumption component of Final Demand.[7] Table 4 presents the lower-bound direct spending vectors we used as inputs in the I−O analysis. The I−O model then calculates the direct and indirect input requirements throughout the economy to deliver the additional consumer goods and services. We remind the reader that the direct expenditures by residents of the Metro Area are not included in this stimulus analysis because of the prevailing assumption that their expenditures on an entertainment event within their Metro Area simply substitute for a like amount of other spending within the Area. Of course, this means that any indirect effects of the spending by local patrons at these venues does not factor in as well.

The results for the three venues (four event types) are presented in Table 5 in terms of gross output (business sales revenue), regional GDP, personal income, and employment. The percentage impacts with respect to these macroeconomic indicators[8] are presented in parentheses in the table as well. For the MLB Stadium, the $53 million additional direct spending translates into $113 million of total additional economic activity in the Metro Area in terms of gross output, $68 million

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7 For all three venues, the patron expenditure needed to be further disaggregated to match the sectoring scheme of the regional I−O table. This required disaggregating some general categories of expenditure into disaggregated IMPLAN sectors. This was done by using the gross output of the relevant IMPLAN sectors as weights.

8 Note that we are performing an economic consequence analysis, rather than a benefit-cost analysis (see Rose, Avetisyan, and Chatterjee 2014, for a discussion of the distinction). This means that we are using macroeconomic indicators, rather than what are termed "welfare measures" (measures of economic well-being), such as equivalent variation approximations to consumer surplus. However, it has become standard to use personal income as a proxy for such measures.

Table 4: Direct spending vectors used as inputs in the I–O analysis – lower-bound estimate (in millions of 2018$).

Sector #	Description	MLB Stadium	NBA Arena	NHL Arena	MACC
37	445 Food & Beverage Stores	1.7	0.2	0.0	5.0
38	446 Health & Personal Care Stores	0.8	0.1	0.0	3.0
39	447 Gasoline Stations	0.4	0.0	0.0	1.4
40	448 Clothing & Accessories Stores	1.1	0.1	0.0	4.2
41	451 Sporting Goods, Hobby, Book, & Music Stores	0.5	0.0	0.0	0.9
42	452 General Merchandise Stores	1.8	0.2	0.0	4.2
43	453 Miscellaneous Store Retailers	0.6	0.1	0.0	2.0
49	485 Transit & Ground Passengers	3.6	0.0	0.0	28.9
66	532 Rental & Leasing Services	0.0	0.5	0.1	0.0
77	711 Performing Arts & Spectator Sports	24.5	7.3	1.6	54.7
78	712 Museums & Similar	0.3	0.0	0.0	4.5
79	713 Amusement, Gambling & Recreation	3.3	0.3	0.1	68.8
80	721 Accommodations	5.8	0.5	0.1	169.0
81	722 Food Services & Drinking Places	9.0	0.9	0.2	31.9
	Total	**46.6**	**9.5**	**2.1**	**357.8**

The bold values in the last row represent the total increased direct spending in each venue.

of additional GDP, $46 million of personal income, and 1,075 additional jobs.[9] The ratio of total additional gross output to direct spending is 2.11 (the size of the gross output multiplier).[10] This means every dollar of direct spending within the Metro Area generates an additional $1.11 within its boundaries.

The results for the NBA and NHL Arena are presented next in Table 5 in terms of the four major macroeconomic indicators. For the NBA events, the $10 million additional direct spending translates into $21 million of total additional economic activity in the Metro Area, $13 million of additional GDP, $8 million of personal income, and 202 additional jobs. For the NHL events, the $2.2 million additional direct spending translates into $4.6 million of total additional economic activity in the Metro Area, $2.8 million of additional GDP, $1.8 million of personal income,

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9 All results in this and other tables in this paper expressed in dollar terms are in 2018 dollars.
10 The multipliers for the three regions (MSAs) in this study are all around 2.0. This is a rather conservative multiplier for large metropolitan areas, in part because it factors out the leakage in the direct and indirect spending stream. In the model we use, income payments are limited, such that they would exclude returns to owners of capital who reside outside the region, and spending on imports of final goods by consumers or imports of intermediate goods by producers is excluded in calculation of indirect and induced effects. Moreover, only demand-side multipliers (upstream supply-chain linkages) are included, and supply-side multipliers (down-stream linkages) are not.

Table 5: Summary economic impacts of increased attendance at the four venue/event types on their MSA regions – lower-bound estimate.

	Output (10^6 $)	GDP (10^6 $)	Income (10^6 $)	Employment (# of jobs)
MLB Stadium	112.7	67.9	45.6	1075
	0.033%	0.033%	0.034%	0.055%
NBA Arena	21.3	13.0	8.3	202
	0.004%	0.005%	0.005%	0.008%
NHL Arena	4.6	2.8	1.8	44
	0.001%	0.001%	0.001%	0.002%
MACC	735.4	462.6	286.8	6166
	0.046%	0.047%	0.050%	0.073%

Output, GDP, income impacts are in millions of 2018$; employment impacts are in number of jobs; % impacts are with respect to regional baseline levels.

and 44 additional jobs. The ratio of total additional economic activity to direct spending is 2.06 in both cases.

For MACC, the $378 million additional direct spending translates into $735 million of total additional economic activity in the Metro Area, $463 million of additional GDP, $287 million of personal income, and 6,166 additional jobs. The gross output multiplier is slightly less than 2.0.

The regional economic impacts for the Arena are the lowest among the three venues, primarily because the average daily spending is only $47.90, compared to $107.60 for the MLB Stadium and $344.10 for the MACC. The Arena also has the smallest percentage of attendees (13.3%) who reside outside of its Metro Area (compared to 32.4% for the MLB Stadium and 30.5% for the MACC).

As a summary of the total economic impacts, the analysis is based on changes in attendance expressed by survey respondents in relation to the countermeasures, which were significantly positive for all three venues. We then applied these attendance changes to average ticket prices and estimated changes in direct business revenues, which ranged between $30 million (for the NBA/NHL Arena) and $59 million (for the MACC) for the lower-bound estimates. We next inserted the direct spending on tickets and other purchases associated with the venue activity into a separate regional economic model for each of the venues. These direct purchases ranged from $13 million to $378 million between the three venues for the lower-bound estimates. The differences in the results arise from the fact that ticket prices and length of stay associated with the trips are much greater for the Metropolitan Area Convention Center than they are for the two sports venues. Generally, the total regional economic impacts in terms of gross output impacts were approximately twice the size of the direct spending due to

multiplier effects, ranging from \$26 million for the NBA/NHL Arena to \$735 million for MACC.

The sectoral results for the MLB Stadium are presented in Appendix Table B1 as an example. Not surprisingly, the most impacted sectors are those associated with the direct tourism spending, such as Performing Arts & Spectator Sports, Retail Trade, Accommodations, Food Services & Drinking Places, and Transit & Ground Passengers Transportation. Other sectors that were most stimulated through intersectoral linkages (the supply-chain effect) include Real Estate, Professional, Scientific & Tech Services, Health Care, and Wholesale Trade.

8 Sensitivity Analysis

8.1 Basic Considerations

The sensitivity analysis was restricted to customers who attended Convention Center events and MLB games over the past four years (2016–2019) and to customers who attended NHL and NBA games over the past three years (2017–2019); customers who attended events before these dates but not after and potential customers who never attended an event were excluded. Sensitivity was assessed using different assumptions about survey responses to produce both upper- and lower-bound estimates of the change in intention to attend future events at the venue.

For each of the four venue/event types, the following three sensitivity checks are examined to produce the lower-bound and upper-bound estimates:

The first sensitivity check uses two different assumptions to represent the number of events attended for customers who selected "two or more events":
- Lower-bound estimate: "Two or more" = three events
- Upper-bound estimate: "Two or more" = five events

The second sensitivity check uses two different methods of calculating the percentage change in attendance:
- Lower-bound estimate: percentage change = the maximum percentage change value across all four countermeasures
- Upper-bound estimate: percentage change = the maximum of either the lower-bound estimate or the sum of the changes across all four countermeasures divided by two[11]

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[11] Logically, the customer changes in attendance are specific to each countermeasure; hence, changes are cumulative across the four countermeasures and should be summed. The upper-

The third sensitivity check uses two different methods for capping percentage change outliers (for customers who indicated that the likelihood of attending will increase by more than 100%):

– Lower-bound estimate: percentage change is capped at 100%
– Upper-bound estimate: percentage change is unaltered

For the lower-bound case, we used a combination of the three lower-bound estimates for the above three assumptions, while for the upper-bound case, the three upper-bound estimates were used.

8.2 Sensitivity Estimates of Changes in Attendance

In Appendix Table C1, the results of the sensitivity test to establish both lower-bound and upper-bound estimates for the responses to the survey are presented. The differences in estimates in the table are due to the combined effects of all three variations in assumptions described above.

We use the percentage change in attendance to modify the direct input into the I–O model. The difference between the lower-bound and upper-bound estimates depends primarily on whether future attendance increases are capped at 100%, and to a smaller extent on whether attendance increases are aggregated over countermeasures by assuming the maximum increase or halving the sum of the increases across countermeasures. The assumption of whether "two or more" means three games or five games has no impact on this direct input to the I–O model. For example, for attendance from inside the metro to the MLB venue, there is a difference of nearly 40% between the upper-bound estimate (63.5%) and the lower-bound estimate (23.8%). About 80% of this difference is due to whether attendance increases are capped at 100%, and 20% is attributable to how attendance increase responses are aggregated over the four countermeasure enhancements.

8.3 Sensitivity Analysis Results

The effect of the sensitivity tests with respect to percentage changes in likely attendance for the four categories of venues/events are presented in Tables 6 and 7.

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bound estimate captures this, but discounts the results based on considerations of marginally decreasing impact (diminishing returns or redundancy) and perceptions of overlapping multiple countermeasures.

The comparison of the upper-bound and lower-bound estimates in terms of likely increased attendance in Appendix Table C1 indicates the following: The upper-bound estimates are about three times the size of the lower-bound estimates for the MLB Stadium and the NBA Arena activity, and about four times the size of the lower-bound results for the NHL Arena activity and the Metro Area Convention Center. A comparison of the regional economic impacts on GDP and employment is presented in Appendix Table C2. The upper-bound estimates are one-and-a-half times the size of the lower-bound for the NBA games, two times the lower bound for the MLB games and NHL games, and three times the lower bound for the Convention Center activities. The differences between the two sets of upper and lower bounds are due to the fact that spending, other than ticket sales, differs

Table 6: Changes in attendance and ticket sales due to the implementation of countermeasures – upper-bound estimate.

Venue	Attendees from the MSA		Change in ticket sales (10^6 2018$)	Attendees from outside the MSA		Change in ticket sales (10^6 2018$)	Total changes in ticket sales (10^6 2018$)
	Change in likelihood of attendance			Change in likelihood of attendance			
	Percent	**Amount (10^3)**		**Percent**	**Amount (10^3)**		
MLB	63.5%	1285	66.3	45.9%	445	22.9	89.2
NBA	123.1%	722	55.4	70.1%	63	5.8	61.2
NHL	42.6%	290	25.9	17.5%	18	1.7	27.6
MACC	186.9%	3072	149.3	175.4%	1267	73.6	222.9

Sample sizes for attendees inside and outside the Metro Area are the same as in Table 1.

Table 7: Summary economic impacts of increased attendance at the four venue/event types on their MSA regions – upper-bound estimate.

	Output (10^6 $)	GDP (10^6 $)	Income (10^6 $)	Employment (# of jobs)
MLB Stadium	249.38	150.31	100.79	2378
	0.0731%	0.0735%	0.0761%	0.1222%
NBA Arena	32.56	19.91	12.65	310
	0.0064%	0.0074%	0.0078%	0.0122%
NHL Arena	9.59	5.86	3.73	91
	0.0019%	0.0022%	0.0023%	0.0036%
MACC	2,149.18	1,351.84	838.12	18,019
	0.1348%	0.1366%	0.1457%	0.2125%

Output, GDP, and income impacts are in millions of 2018$; employment impacts are in number of jobs; percentage impacts are with respect to regional baseline levels.

significantly by venue. Recall that people attending convention center events tend to stay for a longer duration than for the other events, for example. They are also likely to come from farther distances.

Note, however, that there are no qualitative changes in the results of the sensitivity analyses. This indicates that, while the estimates in this study have a broad range, they are otherwise generally robust.

9 Conclusions

This paper has estimated the impacts of terrorism countermeasures on business revenues and macroeconomic indicators for regions in which our three sample public assembly venues reside. The analysis is based on data obtained from the surveys targeting customers and potential customers at each selected venue. A major set of inputs into the analysis were the changes in attendance expressed by survey respondents in relation to the countermeasures, which were significantly positive for all three venues. We then applied these attendance changes to average ticket prices to estimate changes in direct business revenues, which ranged between $30 million (for the NBA/NHL Arena) and $59 million (for the MACC) for the lower-bound estimates. These results follow from the survey, which indicated that many more patrons were more likely to attend the venues because of the presence of countermeasures than those who are unlikely to attend, though the majority of patrons responded that the presence of countermeasures did not make a difference in their likelihood of attending. Note that these direct impacts on business revenues are only one aspect of our estimates because they do not include revenues from concessions and parking; the data did not enable us to separate expenses for these categories at the venue from other spending associated with their visit to the broader venue area.

We then inserted the direct spending on tickets and other purchases associated with the venue activity into a separate regional economic model for each of the venues. These direct purchases ranged from $13 million to $378 million between the three venues for the lower-bound estimates. The differences in the results arise from the fact that ticket prices and length of stay associated with the trips are much greater for the Metropolitan Area Convention Center than they are for the two sports venues. Generally, the total regional economic impacts were approximately twice the size of the direct spending due to multiplier effects.

We performed sensitivity analyses on key assumptions underlying the calculations of the changes in intended attendance. Upper-bound estimates were typically three to four times those of lower-bound estimates with respect to ticket sales, and one and one-half to three times the size of lower-bound estimates with

respect to regional economic impacts. The sensitivity analyses, however, did not change the results qualitatively, and thus, although our estimates cover a broad range, they are generally robust.

Our findings suggest that policies to deploy or enhance security counter-measures at public venues are likely to result in increased revenues to their owners and economic gains to businesses and households in their host region. Our survey and economic analysis indicate that concerns about negative patron reaction to these countermeasures are unfounded and should not deter business and government from protecting the public.

We also identified several gaps in the general literature on our topic and in our own analysis. For example, more research is needed on the substitution effects of broader changes in attendance at all types of public assembly sites. For example, increased patronage of a given local venue event may not simply be a substitute for another local expenditure but rather a substitute for travel plans to other locations, and, in such cases, the spending associated with the increased venue attendance should be counted as an additive to the local economy. But the greatest potential for future research is in generalizing our analysis and methods. This would include examining spillover effects at other public venues such as shopping malls, hotels, amusement parks, theatres, and concert halls. It might also be applied to analyzing modern countermeasures such as facial recognition and other biometric identification technologies. Finally, our methodology can be applied to investigating spillover effects of countermeasures designed to reduce crowd vulnerability to contagious disease, such as entry checkpoints to screen for disease symptoms and/or scanning of an entry certificate confirming the attendee is healthy and/or vaccinated, or adequately safeguarding the well-being of oneself and others through the use of personal protective equipment and social distancing.

Appendix A: Mathematical Formulations of Input–Output Analysis

The mathematical expression of the technological relationships of production captured in the I–O model can be written as Equation 1. This is based on all market purchases and sales between producing sectors in an economy (see Miller and Blair 2009; Rose and Miernyk 1989).

$$X_i = X_{i1} + X_{i2} + \ldots + X_{in} + Y_i \, (i = 1 \ldots n) \tag{1}$$

where

- X_i = total gross output of sector i,
- Y_i = final demand for the products of sector i,
- X_{ij} = the sales by sector i to each of the other sector j,
- n = total number of producing sectors in the economy.

Three assumptions enable equation 1 to be converted into a model capable of analysis and prediction. They are that: a) each commodity or service is provided by a single production sector, and that there are no joint products; b) each sector's inputs bear a direct proportional relationship to that sector's output; and c) there are no external economies or diseconomies.

Assumption (b) may be written as:

$$X_{ij} = a_{ij} X_j \tag{2}$$

where

- a_{ij} = amount of input from sector i required to generate each dollar of output of sector j; they represent model's 'technical coefficients'.

Substituting (2) in equation (1) yields the basic I–O model:

$$X_i = \sum_{j=1}^{n} a_{ij} X_j + Y_i \, (i = 1 \ldots n) \tag{3}$$

Equation (3) can also be written compactly in matrix notation as:

$$X = AX + Y \tag{4}$$

where

- X = Vector of industry total gross output,
- A = Technical coefficient matrix,
- Y = Vector of industry final demand.

Solving for annual gross output needed to deliver the exogenously given set of final demands yields:

$$X = (I - A)^{-1} Y \tag{5}$$

This can also be interpreted as:

$$\Delta X = (I - A)^{-1} \Delta Y \tag{6}$$

where

- ΔX = Vector of changes in industry total gross output,

– ΔY = Vector of changes industry final demand.

In Section 6.4, we first estimate the vectors of direct spending changes stemming from the changes of attendance in each of the four venue/event types because of the deployment of the countermeasures (ΔY). These vectors are then used as the inputs to the I–O model to calculate the economic impacts of changes in attendance.

Appendix B: Sectoral Economic Impacts

Appendix Table B1: Sectoral economic impacts of increased attendance at the MLB Stadium on the MSA Region – lower-bound estimate.

Sector	Direct spending (10^6 \$)	Gross output (10^6 \$)	GDP (10^6 \$)	Personal income (10^6 \$)	Employment (jobs)
1 111 Crop Farming	0.00	0.01	0.01	0.00	0
2 112 Livestock	0.00	0.01	0.00	0.00	0
3 113 Forestry & Logging	0.00	0.00	0.00	0.00	0
4 114 Fishing, Hunting & Trapping	0.00	0.01	0.00	0.00	0
5 115 Ag & Forestry Svcs	0.00	0.00	0.00	0.00	0
6 211 Oil & Gas Extraction	0.00	0.33	0.27	0.29	1
7 212 Mining	0.00	0.03	0.01	0.00	0
8 213 Mining Services	0.00	0.03	0.02	0.02	0
9 221 Utilities	0.00	1.38	0.59	0.24	1
10 230 Construction	0.00	0.79	0.41	0.28	5
11 311 Food products	0.00	0.55	0.13	0.08	1
12 312 Beverage & Tobacco	0.00	0.42	0.12	0.05	1
13 313 Textile Mills	0.00	0.00	0.00	0.00	0
14 314 Textile Products	0.00	0.01	0.00	0.00	0
15 315 Apparel	0.00	0.00	0.00	0.00	0
16 316 Leather & Allied	0.00	0.00	0.00	0.00	0
17 321 Wood Products	0.00	0.04	0.01	0.01	0
18 322 Paper Manufacturing	0.00	0.09	0.02	0.02	0
19 323 Printing & Related	0.00	0.12	0.05	0.04	1
20 324 Petroleum & Coal Products	0.00	0.66	0.26	0.04	0
21 325 Chemical Manufacturing	0.00	0.16	0.05	0.03	0
22 326 Plastics & Rubber Products	0.00	0.06	0.02	0.01	0
23 327 Nonmetal Mineral Products	0.00	0.09	0.04	0.02	0
24 331 Primary Metal Mfg	0.00	0.00	0.00	0.00	0

Appendix Table B1: (continued)

Sector		Direct spending (10^6 \$)	Gross output (10^6 \$)	GDP (10^6 \$)	Personal income (10^6 \$)	Employment (jobs)
25	332 Fabricated Metal Products	0.00	0.09	0.03	0.02	0
26	333 Machinery Mfg	0.00	0.01	0.00	0.00	0
27	334 Computer & Electronic Products	0.00	0.03	0.01	0.01	0
28	335 Electrical Eqpt & Appliances	0.00	0.01	0.00	0.00	0
29	336 Transportation Eqpmt	0.00	0.05	0.02	0.02	0
30	337 Furniture & Related Products	0.00	0.04	0.01	0.01	0
31	339 Miscellaneous Mfg	0.00	0.05	0.02	0.01	0
32	42 Wholesale Trade	0.00	2.47	1.65	0.97	10
33	441 Motor Veh & Parts Dealers	0.00	0.41	0.32	0.21	3
34	442 Furniture & Home Furnishings	0.00	0.15	0.10	0.06	1
35	443 Electronics & Appliances Stores	0.00	0.08	0.05	0.06	1
36	444 Bldg Materials & Garden Dealers	0.00	0.29	0.18	0.11	3
37	445 Food & Beverage Stores	1.67	2.14	1.47	0.99	29
38	446 Health & Personal Care Stores	0.84	1.05	0.66	0.46	11
39	447 Gasoline Stations	0.39	0.49	0.31	0.25	7
40	448 Clothing & Accessories Stores	1.07	1.35	0.82	0.39	16
41	451 Sporting Goods, Hobby, Book, & Music Stores	0.49	0.60	0.39	0.28	11
42	452 General Merchandise Stores	1.77	2.27	1.47	0.92	31
43	453 Miscellaneous Store Retailers	0.62	0.78	0.48	0.42	20
44	454 Non-Store Retailers	0.00	0.50	0.26	0.07	4
45	481 Air Transportation	0.00	0.42	0.21	0.11	1
46	482 Rail Transportation	0.00	0.07	0.04	0.02	0
47	483 Water Transportation	0.00	0.00	0.00	0.00	0
48	484 Truck Transportation	0.00	0.55	0.26	0.22	3
49	485 Transit & Ground Passengers	3.62	4.07	1.72	2.23	67
50	486 Pipeline Transportation	0.00	0.04	0.04	0.07	0
51	487 Sightseeing Transportation	0.00	0.23	0.12	0.10	1

Appendix Table B1: (continued)

Sector	Direct spending (10^6 \$)	Gross output (10^6 \$)	GDP (10^6 \$)	Personal income (10^6 \$)	Employment (jobs)
52 492 Postal service, Couriers & Messengers	0.00	0.49	0.33	0.27	4
53 493 Warehousing & Storage	0.00	0.25	0.15	0.13	3
54 511 Publishing Industries	0.00	0.42	0.29	0.14	1
55 512 Motion Picture & Sound Recording	0.00	0.14	0.09	0.05	1
56 515 Broadcasting	0.00	0.54	0.16	0.07	1
57 517 Telecommunications	0.00	1.98	0.98	0.31	3
58 518 Internet & Data Process Svcs	0.00	0.32	0.13	0.12	1
59 519 Other Information Services	0.00	0.22	0.07	0.05	0
60 521 Monetary Authorities	0.00	0.90	0.58	0.31	3
61 522 Credit Intermediation & Related	0.00	0.85	0.47	0.45	5
62 523 Securities & Other Financial	0.00	1.50	0.53	0.51	9
63 524 Insurance Carriers & Related	0.00	3.06	1.49	0.93	11
64 525 Funds, Trusts, & Other Financial Vehicles	0.00	0.49	0.20	0.04	2
65 531 Real Estate	0.00	10.16	7.01	0.57	28
66 532 Rental & Leasing Svcs	0.00	0.38	0.22	0.10	2
67 533 Lessor of Nonfinance Intangible Assets	0.00	0.49	0.29	0.01	0
68 541 Professional, Scientific & Tech Svcs	0.00	5.74	3.74	3.23	36
69 551 Management of Companies	0.00	1.76	1.13	0.96	7
70 561 Admin Support Svcs	0.00	2.69	1.86	1.50	36
71 562 Waste Mgmt & Reme-diation Svcs	0.00	0.37	0.18	0.12	2
72 611 Educational Svcs	0.00	0.69	0.44	0.42	12
73 621 Ambulatory Health Care	0.00	2.29	1.52	1.39	19
74 622 Hospitals	0.00	1.39	0.79	0.71	9
75 623 Nursing & Residential Care	0.00	0.39	0.25	0.24	6
76 624 Social Assistance	0.00	0.43	0.28	0.26	10
77 711 Performing Arts & Spectator Sports	24.51	27.89	17.44	14.55	318
78 712 Museums & Similar	0.28	0.31	0.15	0.16	4

Appendix Table B1: (continued)

Sector	Direct spending (10^6 \$)	Gross output (10^6 \$)	GDP (10^6 \$)	Personal income (10^6 \$)	Employment (jobs)
79 713 Amusement, Gambling & Recreation	3.35	3.82	2.47	1.05	39
80 721 Accommodations	5.78	5.81	3.49	1.75	56
81 722 Food Svcs & Drinking Places	9.03	11.27	6.46	4.33	179
82 811 Repair & Maintenance	0.00	0.94	0.65	0.53	9
83 812 Personal & laundry Svcs	0.00	0.48	0.30	0.36	12
84 813 Religious, Grantmaking, & Similar Orgs	0.00	0.54	0.41	0.22	4
85 814 Private Households	0.00	0.05	0.05	0.05	4
86 92 Government	0.00	0.65	0.64	0.53	7
Total	**53.41**	**112.71**	**67.94**	**45.55**	**1075**

The bold values presented in the last row represent the total impacts (in terms of Direct Spending, Gross Output, GDP, Personal income, and Employment, respectively) of increased attendance at the MLB Stadium on the MSA Region.

Appendix C: Comparison of lower-bound and upper-bound results

Appendix Table C1: Lower-bound and upper-bound estimates of changes in attendance.

Venue	Attendees from the MSA		Attendees from outside of the MSA	
	Lower-bound estimate	Upper-bound estimate	Lower-bound estimate	Upper-bound estimate
MLB	23.8%	63.5%	20.8%	45.9%
NBA	41.2%	123.1%	45.8%	70.1%
NHL	11.7%	42.6%	8.4%	17.5%
MACC	42.8%	186.9%	60.0%	175.4%

Sample sizes for attendees inside and outside the Metro Area are the same as in Table 1.

Appendix Table C2: Comparison of the economic impacts lower-bound and upper-bound estimates.

	Lower-bound		Upper-bound	
	GDP (10^6 \$)	Employment (# of jobs)	GDP (10^6 \$)	Employment (# of jobs)
MLB Stadium	68	1,075	150	2,378
NBA Arena	13	202	20	310
NHL Arena	3	44	6	91
MACC	463	6,166	1,352	18,019

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