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Civilian Aviation Screening: A Time-Series Analysis of Confiscated Firearms at Screening Checkpoints

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CIVILIAN AVIATION SCREENING:
A TIME-SERIES ANALYSIS OF CONFISCATED FIREARMS AT SCREENING CHECKPOINTS

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DEDICATION

This thesis is dedicated to my parents

Don and Lorna Agard

for their unconditional love and support.

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ABSTRACT

This study investigated the aviation screening process and sought to determine if the federalization of the screening process had any effect on the number of firearm confiscations at civilian aviation screening checkpoints. The hypothesis of the study was that airport screening firearms confiscations (per one million screenings) were lower before the U.S. government (TSA) took over screening in 2001-2002. This quantitative research required the performance of an interrupted time series analysis. Interrupted time series analysis evaluates the impact of one or more events on the values in the time series. An interrupted time series analysis attempts to determine whether an outside event affected subsequent observations. For an example, did the implementation of a new economic policy improve economic performance, did a new gun ordinance reduce violent crimes; or in this study, did the federalization of civilian airport screening increase the number of confiscated firearms. Such comparison of an interrupted time series was applied to this study of firearm confiscations at airport checkpoints.

Due to limited publically available data and inconsistencies in data collection, firearms were the only category of confiscations available that provided sufficient data points (years of data) to conduct quantitative research. The first data set includes persons screened and firearms confiscated from years 1990 through 2000. The second set of data includes persons screened and firearms confiscated from years 2003 through 2009. The total data that was used spans a twenty year period (1990-2009). An examination the theoretical screening process model used by the private sector and the process model currently in use by the Transportation Security Administration (TSA) was performed to

determine if any technological advances or changes in screening process may have had an effect on the statistical results.

The results of the investigation revealed the following findings:

1. There was no statistically significant difference between the number of firearm confiscations by private screeners and the number of firearms confiscated by government screeners.

2. Advancements in screening technology and screening processes had little to no effect on the number of confiscated firearms between both theoretical process models.

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Background

An Eastern Airlines Flight 1320 en route from Newark New Jersey to Boston, Massachusetts on March 17, 1970, was hijacked by passenger John DiVivo when he entered the cockpit with a loaded gun ordering the crew to continue flying the plane until it ran out of fuel and crashed. The crew fought back managing to disarm DiVivo and shot him. First Officer James Hartley was mortally wounded during the altercation and Captain Robert Wilbur was injured during the flight but managed to land the plane safely. In 1974, Samuel Byck, using a stolen pistol, shot and killed an airport police officer before attempting to hijack an aircraft with the intent to crash it into the White House. Byck boarded a Delta Airlines DC-9 and ordered the pilots to take off. When the pilots refused, they were both shot, killing the first officer. An FBI agent ended the altercation when he fired though a window of the aircraft's door killing Byck before the plane was able to take off (Price, 2009).

The Federal Aviation Act of 1958 created the Federal Aviation Administration (FAA) and was foundation of policies, procedures and regulations in the aviation industry. It wasn't until the 1960s did aviation security become an issue. In 1961, Antuilo Ramierez Ortiz used a gun to force the flight crew of a National Airlines' jet to divert to Cuba and thus became the first U.S. hijacker (Department of State, 2006). The Federal Aviation Administration (FAA) began the Sky Marshal program, its first major security program, in 1968. The program placed undercover law enforcement officers or antiterrorist agents on board commercial aircrafts to counter aircraft security incidents

Prior to the 1970s, airports had minimal security, but the sudden rise in airport incidents and aircraft hijackings led to the implementation of security measures. The Anti-Hijacking Act of 1971 was the first aviation security act that outlined punishments for hijackers and mandated passenger screening but not the screening of carry-on baggage. During this time, airlines voluntarily implemented security screening of baggage and passengers. In 1972, the FAA began requiring that all airlines screen passengers and their carry-on baggage by 1973. The Anti-Hijacking Act of 1974 required the screening of all passengers and all property. The act placed the responsibility for passenger screening onto the air carriers. Screening services were generally contracted to private security companies by air carriers. Airlines that had operational control of individual concourses provided security services at a checkpoint. Although security services were contracted out to private companies, the FAA had regulatory oversight of security processes. This was highly criticized as screening services were typically contracted out to the lowest bidder rather than the most effective screeners.

The 1980s began with a new round of hijackings from the United States to Cuba setting a record of eighteen in 1980 and fifteen more in 1983 (Department of State, 2006). Soon after, a bilateral anti-hijacking agreement between the United States and Cuba, effectively ended hijackings between the two countries. In 1985, the FAA restarted the Sky Marshal program and transformed it into the Federal Air Marshal Service which continues to operate today. By 1990, the implementation of new policies led to a significant decrease in attacks on aviation and was followed by more than ten years of relative calm in aviation security. This decrease was in large part due to the Aviation Security Improvement Act of 1990. The act led to more comprehensive regulations on

access control systems for airports and also required the screening of airport and airlines personnel.

Characteristics of hijackings during the 60s, 70s, and 80s were often only one or two hijackers that used guns, grenades, bombs, or the threat of a bomb to take over a flight. A premise in hijackings before 9/11 was that hijackers were more interested in an outside cause (escape, extortion, political message) than in using the aircraft as a guided missile. Thurs, before 9/11 the goal of the flight crews during a hijacking was to land the aircraft so authorities on the ground could take over negotiations. This assumption does not work in a post-9/11 world where aircraft are used as weapons of mass destruction and hostages are merely victims to the end result (Price, 2009). With the more recent motivation of hijacking planes to be used as guided missiles against ground targets, the threat of seizing a plane by gun is still prominent.

The most elaborate terrorist attack in U.S. history occurred on September 11, 2001, when 19 hijackers boarded four domestic flights throughout the United States. The results included the deaths of nearly 3,000 civilians, military deployments in two countries, and a complete transformation of American aviation and homeland security. In response to the September 11th, 2001, attacks, the Aviation and Transportation Security Act (ATSA) was enacted by congress on November 19th, 2001 (ATSA, 2001). This act created the Transportation Security Administration (TSA) within the U.S. Department of Transportation. TSA's primary responsibility is for the safety and security of the traveling public in the United States. TSA oversees security for highways, railroads, buses, mass transit systems, pipelines, and ports, but the majority of the TSA's efforts are in aviation security. Aviation security consumes approximately 71% of the TSA's annual

budget which amounts to approximately 4.8 billion dollars (Congressional Report, 2008). Proponents of the TSA argued that a single federal agency would better protect air travel than the private companies who operated under contract to single airlines or groups of airlines that operated terminals. The federal and state governments and general aviation industry all play a role in securing general aviation operations. While the federal government provides guidance, enforces regulatory requirements, and provides some funding, the bulk of the responsibility for assessing and enhancing security falls on airport operators.

The Homeland Security Act of 2002 was established in November 2002 with the intention to consolidate U.S. executive branch organizations related to the security of the United States. Twenty two government agencies were moved under the new Department of Homeland Security. The TSA was moved from the Department of Transportation to the Department of Homeland Security in March 2003 (107th Congress, 2002).

Statement of the Problem

Since the federalization of civilian aviation screening, no major terroristic events have occurred in the United States involving a firearm. However, security breaches and incidents are disturbingly common. Several issued reports show the failure of undercover security tests at checkpoints where TSA personnel failed to detect explosive devices, guns, and other weapons (GAO, 2007). Criticism involving the level of security and violations of personal privacy remain major issues to be confronted by the TSA. Questions remain as to whether the government takeover of screening services has improved security over its private counterparts prior to 9/11. A significant amount of resources have been allocated towards the improvement of aviation security. Within

aviation security, passenger and baggage screening are the most important and visible processes mitigating potential threats to the aviation environment. But this still leaves the question of has the federalization of security screening brought about change in the amount of confiscated firearms?

Purpose of the Study

Observing and experiencing the transformation of aviation security here in the United States throughout life and reviewing past research led to performing a policy analysis of the federalization of the airport screening and confiscated weapons. Has the government takeover of airport screening in 2001-2002 increased the number of firearm confiscations at screening checkpoints? This study probes if the federalization of the aviation screening process had any effect on the rate of confiscated weapons at airport screening checkpoints. I hypothesize that airport screening firearm confiscations (per one million screenings) were lower before the U.S. government (TSA) took over screening in 2001-2002.

Potential Significance

The potential significance of this research is that it challenges the current and past screening models used by the private and public sectors. The results may help illustrate the differences and similarities in each checkpoint screening model. The findings of this study may provide quality information to our policy and lawmakers to assist them in making informed decisions on aviation security and to continually improve our screening models and methods.

Organization of the Study

This study is presented in chapters as follows. Chapter 1 provides an introduction that briefly addresses the purpose of the study and the relevance of the research. Chapter 2 presents a review of related literature. The literature is reviewed in the areas of aviation security policy and regulation, public perception/privacy, screening technology and performance, and applications of time-series analysis. In Chapter 3, the methodology for the study is explained. Quantitative research is presented as the primary type of research used in this study. A time-series analysis was conducted from archival data and descriptive data obtained from government reports. Chapter 4 includes the research findings and analysis. Discussions and implications of the findings are included in Chapter 5. References and Appendices are included in Chapter 6.

Chapter 2

Literature Review

This study seeks to expand the research on civilian aviation security and the civilian and baggage screening process by focusing on the 2001-2002 federalization of screening and its impact on confiscated firearms at screening checkpoints.

Applicable research that is available relates to policy and regulation, screening technology and performance, public perception and applications of time series analysis. Some issues may have the tendency to overlap into more than one category. Policy changes may impact the screening technology used, which may lead to a change in public perception. A good example of a policy which led to changes in screening technology and public perception is the implementation of active millimeter wave and backscatter technologies or commonly referred to as full-body scanners. The literature review was designed to explore these four areas of research.

Policy and Regulation

Since the terrorist attacks on the United States in September 2001, there has been a growing awareness of the risk to aviation and other forms of transportation from terrorism. This has encouraged governments and international organizations to develop strategies to reduce the risk of such attacks. George and Whatford (2007) examined the continuously expanding range of regulatory initiatives that have impacted the many forms of public transportation, but specifically examining aviation. The goal was to define the common practices that were required in order to strengthen aviation security.

George and Whatford (2007) explored this issue through a series of case studies and document analysis and examining international security policies and regulations. Some of the documentation examined included regulations from the European Union, the Federal Aviation Administration, and the International Civil Aviation Organization. Various organizations, regulatory bodies and associations have provided governments with direction when developing their own domestic regulation. The first convention that addressed aviation crime was the 1963 Tokyo Contention on Offences and Certain Other Acts Committed on Board Aircraft. This was the grandfather of aviation regulation and law that established rules on jurisdiction. One of the more modern and most important international organizations in the aviation sector is the International Civil Aviation Organization (ICAO). The ICAO is a specialized agency of the United Nations headquartered in Canada. The ICAO Aviation Security Plan of Action carries out regular mandatory audits to ensure aviation security measures are in place at all participating territories. Other regulating bodies include the International Air Transport Association and the Federal Aviation Administration (FAA). Whatford found that the following is a consensus of what needs to occur in order to strengthen aviation security: (1) The intelligence structure and mode of operation within central government need to be complemented with the work and contingency plans of the police and the private security industry, and the private sector. (2) There must be coordination and collaboration afforded across both domestic and international security structures. (3) An effective international legal and financial framework must be established.

In 2004, the Government Accountability Office (GAO) examined the state of general aviation security through determining what actions the federal government has

taken to identify and assess threats and vulnerabilities to general aviation, the steps the federal government has taken to strengthen general aviation security and along with the challenges that the government faces, and what steps non-federal stakeholders have taken to enhance the security of general aviation (GAO, 2004a).

The methodology used in examining the state of general aviation security and to answer the questions presented by the GAO was the use of qualitative research through conducting interviews with federal agents, quantitative research though analyzing data from the FAA, and examining documentation from various agencies. GAO officials interviewed individuals in the Transportation Security Administration's (TSA) Office of Transportation Security Policy, Office of Operations Policy, and General Aviation Operations and Inspections Office on TSA's role in enhancing general aviation security. Documentation obtained from various government agencies such as the TSA, Federal Bureau of Investigations (FBI), and Central Intelligence Agency (CIA) was examined on providing means of obtaining and disseminating intelligence information, intelligence regarding potential terrorist misuse of general aviation, and documented plans to implement a risk management approach to assess threats and vulnerabilities to civil aviation.

The GAO found that federal and state governments and general aviation industry all play a role in securing general aviation operations. While the federal government provides guidance, enforces regulatory requirements, and provides some funding, the bulk of responsibility for assessing and enhancing security falls on airport operators. Although a very limited assessment of general aviation has been done, a systematic assessment of threats has not been conducted. The TSA plans to issue a self-assessment

tool to assess airport vulnerabilities for airport operators' use, but does not plan to conduct on-site assessments at all airports due to cost and other factors. TSA has not yet developed an implementation plan for its risk management efforts. TSA and the Federal Aviation Administration (FAA) have taken steps to address security risks through regulation and guidance such as regulating background checks for U.S. flight training schools, however they still face challenges in further enhancing security. The FAA has not established written policies and procedures for reviewing and validating the need for flight restrictions. Non-federal aviation stakeholders have partnered with the federal government and have taken steps to enhance security. Proof of this partnership between private organization and the TSA have led to the development of the Airport Watch Program. The Aircraft Owners and Pilots Association (AOPA) has partnered with the Transportation Security Administration (TSA) to develop a nationwide Airport Watch Program that uses more than 600,000 pilots as eyes and ears for observing and reporting suspicious activity (AOPA, 2011). According to the AOPA's website, the Airport Watch Program includes warning signs for airports, informational literature, and a training video to teach pilots and airport employees how to enhance security at their airports.

Patankar and Holscher (2000) examined the technical and strategic measures that have been implemented to address the key issues in providing optimum levels of security without compromising the public's accessibility to airports. It focuses on the technical and organizational initiatives implemented in the years since Pan Am Flight 103 disaster in 1988. Her study examines aviation security in the pre-9/11 era and was published in 2000.

The methodology that was used included examination of document analysis, historical research of screening data used and case studies that have been performed in the past. In addition, reports published by congress and published recommendations to the FAA were assessed to determine what screening and security initiatives were in place.

The findings show that a variety of screening techniques must be used to provide reliable security, yet most airports do not apply such techniques. At the time of the study, security systems at most airports were single-layered. The paper concludes that the classic law of requisite variety (an intelligent enemy requires an intelligent fortification) applies to airport security systems. Patankar and Holscher presented a model of aviation security systems that is believed to provide continuous security and safety. This model analyses the profiles of passengers on every flight, and then identifies a fixed percentage of passengers who do not fit the normal profile. They claim that such technique is likely to provide active threat reduction.

Patankar's and Holscher's model of analyzing profiles of passengers closely resemble the Computer Assisted Passenger Prescreening System (CAPPS) program that was implemented around the time their study was released in response to the perceived threat of domestic and international terrorism. Upon booking a flight, identifying information would be collected by the airline and ran against stored data to determine if the passenger was a risk to safety. The passenger would be assigned a "risk score" that could possibly require the person to be subject to additional screening. Additional forms of passenger screening programs have since been utilized including CAPPS II, Secure Flight, and various Trusted Traveler programs.

As a result of TWA Flight 800, President Bill Clinton established the White House Commission on Aviation Safety and Security. Chaired by Vice President Al Gore, the commission was commonly referred to as the "Gore Commission" (Price, 2009). The most significant finding of the Gore Commission was that the federal government should considered aviation security to be a national security issue. The commission said that that aviation security was essentially a government responsibility which was welcomed relief to the aviation industry. The commission assisted in formulating the Aviation Security and Anti-Terrorism Act of 1996 which required airports to conduct threat and vulnerability assessments every three years at each airport. The act required fingerprinting and more extensive criminal history checks for all screeners and airport personnel. The Computer-Assisted Passenger Prescreening System (CAPPS) was developed that required passengers to input personal information upon buying an airline ticket that would be used in assessing the individual's threat level. The commission wanted deployment of explosive detection and explosive trace systems at airports around the country and sought to expand the use of bomb-sniffing dogs.

According to Szyliowicz (2003) the most dramatic policy change in United States aviation security was the development of the Department of Homeland Security. The first steps that took place were the most immediate to prevent further hijackings which included reinforced cockpit doors and an increase of air marshals on flights. Szyliowicz (2003) mentions that the most visible change was the implementation of the Transportation Security Administration, which replaced the passenger screeners that were employed as screeners. Currently the TSA employs approximately 55,000 federal workers.

Public Perception and Privacy

The issue of privacy and security has been a significant debate today in regards to preserving privacy while ensuring public safety. Chahal (2007) documented the perceptions of travelers based on the policy and security changes post 9/11. Sixteen interviews were conducted to collect observations based on the perceptions of travelers at three airports in the eastern and central United States. Chahal's research also includes the perceptions of airport personnel of the new aviation guidelines since 9/11.

Chahal (2007) found three main themes in which the perceptions of people in airports were classified. These categories were: those who feel the new regulations are necessary updates; those who qualify the necessity of updates; and those who feel that the new regulation updates are unnecessary. Those who believe the regulation updates are necessary are frequent flyers that support the new security protocol. Those who qualify the necessity of the security updates were vacationers who do not travel consistently and, thus their perspectives are based on their inconvenience, either support or are against the new protocols. The final group believes the regulations are not necessary. This group contains people who fly as a last resort and thus do not want to deal with security and the new protocol involved. Chahal (2007) labels this group as emergency flyers.

It was found that there is a conflict between the issues of public safety and the preservation of privacy. Observations of the confusion of what is considered public and what is considered private is discussed. It is concluded that due to the grey area where private and public overlap, it is difficult to create and sustain a safe environment without intruding travelers' privacy.

Drawing upon published research, observations, and analyses of relevant current and recent trends, Levi and Wall (2004) explore the longer term impact of the post-September 11 changes in the security and privacy discourse. Levi compares the privacy and security reactions of 9/11 between the European Union and the United States.

The results of the study show that the barriers to data sharing between public and private sectors appear to be lower in the United States than in the European Union. Levi (2004) states that "probably the most significant impacts of securitization are to be found in the United States, where the events of September 11 hit the hardest" (p.218). The European Union countries have only experienced changes in procedures. Not the major institutional change that the United States experienced. Levi attributes the lack of European Union change to Europe's prior experiences of terrorism and the agencies that have been formed prior to 9/11 to combat it domestically. The most pressure for change has risen from the wanting exchange of air traveler information. Privacy concerns are more prevalent in the United States because of its more recent direct exposure to terrorism and the rapid securitization of the country.

Pravone and Esposti (2010) explored the potential technological infringements on privacy and civil rights due to the enhancement of national security that is intended to foster proactive attitudes towards crime. Pavone and Esposti (2010) use qualitative data from focus groups to assess the reasoning of individuals while the trade-off between privacy and security was tested through an analysis of correlations based on survey data.

This post 9/11 perspective is that a safer society is often pursued through the implementation of new security policies trying to prevent the materialization of security threats through increasing reliance on technological devices and data exchange programs

(Zureik and Hindle, 2004). Pavone states that "Although these technologies constitute a potential threat to individual privacy, their introduction has been justified in terms of a beneficial trade-off, whereby the amount of privacy lost is allegedly compensated by an increase in national and social security." (p.5)

The results of Pavone's study showed that technologies should always be employed under specific legal and institutional guarantees. Participants in the study concluded that the introduction of new security technologies should be gradual and transparent, occur with clear rules and information, should be focused on specific places, should be proportionate to the danger and the situation, and should affect the privacy of individuals as little as possible.

Screening Technology and Performance

Although passenger and carry-on baggage screening deters a limited number of threats, specifically bombing and hijackings, it is still one of the most important security layers as the majority of attacks on aviation have been bombings of aircraft or hijackings (Price, 2009). Shanks and Bradley's (2004) *Handbook of Checked Baggage Screening* explains the basic screening process in six phases (p.222-223).

1. The divestiture process. The passenger or employee is called by security staff to remove outer attire and anything that may set off the metal detector, such as belt buckles, watches, jewelry, coins, mobile phones, or PDAs. These items are placed in a polymer container and sent through the X-ray machine. Laptops and personal DVD players are often removed from their containers and placed in separate bins. In the United States, individuals must also remove their shoes, but this policy changes both from airport to

airport and country to country. The individual also loads their baggage onto the bag belt for analysis by the X-ray machine.

2. Passenger screening. The passenger is requested to move through the metal detector. Passengers who set off the detector's alarm are asked to step aside until a secondary search can be conducted, usually consisting of a pat-down or hand wand metal detector. In some instances, passengers may be allowed to go back through the metal detector after divesting themselves of additional items that may have triggered the alarm, rather than going to secondary screening.

3. Carry-on baggage screening. As the passenger is being screened, security staff members analyze the contents of the passenger's bag using conventional X-ray technology or explosive detection system (EDS) technology. Baggage that contains questionable items or threat items is often checked physically through a bag search, analysis of an explosive trace detection (ETD) machine, or in some cases, both. If a bag contains an apparent bomb, then the screener will likely keep the suspect item within the X-ray machine, stop the belt to prevent the bag from advancing out of the machine, and hinder attempts by the owner to pull the bag away from the security staff. The screener will notify law enforcement and supervisory personnel for further assessment of the X-ray image. If the item appears to be a bomb, then an immediate evacuation of the security screening checkpoint and surrounding area may be required. Explosive demolition teams or K-9 explosive detection teams are called to further verify the threat.

4. Exit process. Provided passenger belongings have been cleared through the X-ray analysis, the passengers are reunited with their belongings and allowed to proceed into

the sterile area. The sterile area is a portion of the terminal area in which travelers have passed through security.

5. Special circumstances. Disabled passengers and those in wheelchairs often must be hand searched.

6. Newer technology. New technology is being developed, including explosive trace portals, liquid explosive detectors, and document scanning devices. These technologies are being integrated into the passenger and carry-on baggage screening process.

The standard method of screening in the United States is the use of walk through metal detectors (WTMD) or often called magnetometers. A WTMD creates a magnetic field which is disrupted by the presence of metal. If the disruption is high enough, an alarm will sound. The specific level required to sound an alarm can be set depending on the sensitivity desired. WTMDs only require a second or two to detect metal found on an individual, so passengers can be quickly processed. Although advancements in technology have improved some security equipment and led to the development of new technology and screening processes, the technology and functionality of walk through metal detectors used at screening checkpoints have remained relatively the same since their inception in the 1960s. According to Price (2009), more advanced metal detectors can pinpoint where a metallic object is on an individual. Typically, these advanced detectors divide the magnetic field into many distinct zones and have uniform coverage of the entire person. If a metallic object is detected, the zone will be indicated on the exit side of the detector providing a visual alert of the area where the object is located.

Recent terrorist attacks have been attempted by using liquid explosives. Liquid explosives often do not contain any metallic objects that would be detected by WTMDs.

This led to the implementation of Explosive Trace Portals (ETP) that are used for secondary screening. ETPs are able to detect the presence of explosive material within an object, such as a bag, or on a person. Backscatter X-ray and millimeter wave imaging systems have recently been deployed to most major U.S. airports. The imagery produced is very detailed and shows the body contours of the individual being screened. They reveal nearly any items that someone may attempt to hide beneath clothing including guns, knives, drugs, and explosives. Privacy concerns have been raised by many groups because of the clear and graphic images that are produced by these machines. Millimeter wave imaging sends radio waves to the individual being screened. The feedback produces an image of the individual and clearly reveals nonhuman objects such as explosives and other weapons. The images produced are far less revealing than backscatter but there has been criticism as to the strength of the radio waves being produced by these machines and the concern for individual health.

In August 2005, the TSA reported a record number of firearms being confiscated at airport security checkpoints according to MSNBC. From August 2004 through August 2005 airline travelers surrendered 735 firearms, slightly more than 61 per month. The previous high was 637 firearms surrendered at airport checkpoints in 2003 (Meeks, 2005). The TSA did not speculate why the sudden increase in confiscated firearms occurred.

The ultimate success or failure of security relies on the human factor, specifically, the human screeners that are tasked with detecting abnormalities, risks, and threats. A study by Wolfe (2010) of the Harvard Medical School in collaboration with the Department of Homeland Security's Transportation Security Laboratory examined the

detection rates of screeners. Thirteen volunteers looked for guns and knives in a software-generated stream of images of suitcases and bags filled with typical items. A stream of 200 bags and suitcases would be observed during each period, followed by a two minute break. Wolfe performed two tests, one in which a gun or knife was present fifty percent of the time, and another in which guns or knives appeared two percent of the time. Observers were told that bags without weapons would be "frequent" in the fifty percent prevalence condition, and that bags without weapons would be "rare" in the ninety eight prevalence condition (Wolfe, 2010). Volunteers were told to be as quick and accurate as possible in correctly identifying bags with weapons.

The results of the study indicated that "target prevalence powerfully influences visual search behavior" (Wolfe, 2010). In the first experiment, in which people are told to look for something more common, resulted in them often thinking that they see the targets even if they are not there. The results of the second experiment in which participants were told weapons would only appear two percent of the time showed that when people look for things that are rare, they are not good at finding them. Wolfe (2010) says that "when targets are rare, observers shift response criteria, leading to elevated miss error rates" (p.121). Very high target prevalence tests, in which they were told weapons would be present fifty percent of the time, showed a shift in response criteria in the opposite direction, leading to elevated false alarms during the baggage search. False-alarm rates increased substantially at the high-prevalence level, while miss errors dropped. Wolfe explains:

"We know that if you don't find it often, you often don't find it. Rare stuff gets missed. If you look for 20 guns in a stack of 40 bags, you'll find more of them than if you look for the same 20 guns in a stack of 2,000 bags" (p.124).

Wolfe believes that its an adaptive behavior in nature that can cause problems when people start looking for rare items like guns in baggage. Wolf suggests that there are ways to retain airport screeners to reorient their searching skills. He proposes that error rates may be lowered by offering people in screening positions to simply retrain at the start of every shift. Wolf speculated that "If [screeners] spend a couple of minutes doing a simulates search for common weapons, they might then do a better job at really finding rare ones for the next 30 minutes or so" (Leggiere, 2010, p.1).

The performance of screeners continues to be a challenge for airport operators and security officials. Screening both pre and post 9/11 has been harshly criticized for consistently failing undercover tests performed by government agencies.

Due to long-standing problems with screeners' performance and congressional interest in improving this performance, the GAO reviewed the performance of screening personnel and the efforts being made to improve their performance in a report published in 2000. The following research questions were presented. Since 1990, how accurately have screeners been detecting test objects? What are the causes for screeners' performance problems and what efforts is the Federal Aviation Administration (FAA) making to address them? How do selected foreign countries handle screening operations and do they use practices that could help improve screeners' performance in the US?

The methodology used in assessing the performance of screening personnel and the efforts being made to improve their performance highlighted by the GAO was the use

of quantitative research though reviewing relevant literature focusing on the causes of performance problems and examined past reports on aviation security. To determine the causes of screener's performance problems the GOA reviewed FAA documents that described screening equipment research, development and deployment efforts. Qualitative research was also performed through interviews with representatives of air carriers, security companies and two screening equipment manufacturers and two aviation industry associations to obtain their perspectives on the performance of screeners. GOA representatives visited Belgium, Canada, France, the Netherlands, and the United Kingdom to determine how screening operations are handled in other companies. They met with government and airport officials to discuss the overall framework for passenger screening.

The GAO (2000) found that no single problem causes checkpoint screeners to fail to detect dangerous objects. Some of the problems identified included the rapid turnover among screeners that leaves few experienced personnel at the checkpoints and the inattention to human factors such as the performance of repetitive tasks and the need for adequate training in spotting concealed dangerous objects. The major practices and policies that differed in United States screening from the foreign countries' screening that were examined were that in the majority of countries examined, the GOA found that there was more extensive qualifications and training for screeners, higher pay for screeners, the differences in screening responsibilities assigned an the more stringent checkpoint operations, such as routine searches of passengers. Turnover was also identified as not as significant of a problem in these other countries as it is in the United States.

As discussed previously, the opt-out or Screening Partnership Program (SPP) was a pilot program established by the Aviation and Transportation Security Act of 2001 to study the effectiveness of private companies conducting passenger screening, baggage screening, and inspection (Price, 2009). A 2-year pilot program at five airports testing the effectiveness of private sector screening in a post-September 11 environment concluded on November 18, 2004 (GAO, 2004b). The five airports selected for the pilot program represented different levels of commercial service. These five airports included San Francisco International Airport, Kansas City International Airport, Greater Rochester International Airport, Tupelo Regional Airport, and the Jackson Hole Airport. The GAO assessed the status of the pilot program and TSA's progress in developing a private screening program that allows airports to apply to opt out of using federal screeners, later known as the Screening Partnership Program (SPP). In particular, the GAO assessed TSA's efforts to develop policies and procedures for the opt out program, the guidance TSA has provided to airport operators and private contractors on the plans to develop a program and information about the program, and TSA's efforts to develop performance measures for evaluating the opt-out program and contractor performance.

The methodology used in assessing the effectiveness of private sector screening by the GAO was the use of qualitative research through conducting in person and telephone interviews with federal agents and officials from two aviation associations, the American Association of Airport Executives and the Airports Council International, and examining documentation from various agencies. Documentation that was examined including guidance materials from the TSA, independent consulting studies prepared for

the TSA that evaluated the contract screening pilot program, provisions of the Aviation and Transportation Security Act and other reports addressing the opt-out program.

The GAO found that the TSA have taken steps to communicate information about the opt out program to stakeholders. TSA has posted an opt-out program application for airport operators that asks reasons for wanting to participate in the opt-out program and the preferred timeline for transitioning to private screening operations. However, the GOA found that some airport operators, private screening contractors, and aviation industry representatives indicated that they need additional information about leeway in managing the program, liability protection, and costs relating to the opt-out program. The most frequent reasons for the lack of interest included that the airport was satisfied with TSA screening services, screening is a federal government responsibility and the opt-out program does not allow airports to have managerial control. Liability and contract control and oversight were also important issues. The TSA has been developing performance measures both to assess screening performance from airports and from individual contractors performing screening services. TSA expected to implement contractor-related performance measures in 2005 along with remaining policies and procedures.

In 2007, the TSA awarded a contract to independent consulting firm Catapult Consultants to conduct a cost and performance analysis of airports with private screeners versus airports with federal screeners (GAO, 2009). The contractor used two separate models to develop its cost analysis. Under the first model, the costs of six SPP airports were compared with the costs of six comparable non-SPP airports. Under their second model, they used data from approximately 450 airports to compare costs for each of the six SPP airports to a regression-based model. for a fully federal operation at the same

SPP airport. A regression-based model was used to determine what the SPP airport would cost if it used federal screeners.

According to the TSA, the contractor concluded that the SPP airports have historically cost more to operate, with the two models averaging anywhere from 9 to 17 percent higher costs than if the airports were to use federal screeners (GAO, 2009). When analyzing the performance of screeners, the contractor used four measures including (1) threat image projection detection rates (2) recertification pass rate (3) wait times and (4) customer satisfaction. They examined four years of performance data from 2004 to 2007. The contractor's analysis found that SPP airports' overall performance results are equal to or better than those delivered by non-SPP airports. The results of the study were to be used by senior TSA leadership for making strategic decisions about the state and future of the Screening Partnership Program (SPP). The official report of the study performed by Catapult Consultants were never released to the public.

In 2009, the TSA issued their official report comparing the cost and performance of screening at SPP and non-SPP airports. The TSA compared the cost of operating screening at SPP airports with the cost that would be incurred in the agency's budget if these airports were run as fully federal airports. Screening data was then obtained and ran against the six SPP airports and six non-SPP airports.

Invoice data obtained from six SPP airports was used to determine cost. The six SPP airports included Greater Rochester International Airport, Jackson Hole Airport, Joe Foss Field, Kansas City International Airport, San Francisco International Airport, and Tupelo Regional Airport. The TSA then chose six non-SPP airports of the same airport category (category X, I, II, III, and IV) which included Barkley Regional Airport, Central

Illinois Regional, Logan International Airport, Missoula International Airport, Salt Lake City International Airport and Syracruse-Hancock International Airport.

The TSA analyzed the 2007 performance data for five performance measures including (1) threat image projection detection rates (2) recertification (3) passenger waiting (4) peak wait times and (5) checkpoint capacity utilization. The TSA concluded that screening at SPP airports cost approximately 17.4 percent more to operate than airports with federal screeners and that SPP airports fell within the "average performer" category for performance measures (GAO, 2008). An airport was considered an average performer if the results of the performance measures fell within one standard deviation from the airport category average.

This conclusion came under scrutiny from the Government Accountability Office (GAO) as the TSA failed to include several costs. According to a March 2011 report published by the GAO:

"We reported in January 2009, among other things, that TSA had underestimated costs to the government for screeners at non-SPP airports because the agency did not include all of the costs associated with passenger and baggage screening services at these airports, such as workers' compensation and general liability insurance, and certain retirement benefits to be paid by the Office of Personnel Management to TSA retirees at non-SPP airports. Further, TSA did not reflect the revenue received by the government from corporate income taxes paid by SPP contractors. The omission of these factors reduced the reliability of TSA's 2009 cost estimate by increasing the costs for private-contractor screeners relative to federal screeners" (p.3).

The GAO performed work with the TSA from September 2010 through February 2011 to address three of the seven cost limitations previously outlined. These cost limitations included the cost impact of overlapping administrative personnel, some fringe benefits, and cost comparisons for multiple fiscal years. In the March 2011 updated report, the TSA's new estimation is that the SPP airports would cost 3 percent more to operate in 2011 than airports using federal screeners. This was a significant decrease from their initial report of 17.4 percent in 2009. The TSA has generally addressed 3 of 4 cost limitations but needs to take additional actions to address the remaining 4 limitations related to cost and the 3 limitations related to performance (GAO, 2011).

Three common themes were found that relate to topic of civilian aviation security screening. One theme entailed how federal regulations and policies from both the federal government and private security organizations have impacted aviation screening. A second theme was the way in which the public's perception of civilian aviation screening has transformed over time. Screening technology and performance is a third theme that has greatly impacted aviation security. All three of these themes can interact with each other. Increased regulation has led to the development of new policies and technology that have impacted both the screening technology and the screening process. The advancement of screening technology has led to concerns over personal privacy.

Chapter 3

Methodology

Context of the Study

The criticism of the level of security and violations of personal privacy remain to be major issues confronted by the TSA. Several issued reports show the failure of undercover security tests at checkpoints where TSA personnel failed to detect explosive devices, guns, and other weapons (GAO, 2007). Billions in taxpayer money have been spent since the government takeover of aviation screening. Questions remain as to whether the government takeover of screening services has improved security over its private counterparts prior to 9/11. This study probed if the federalization of the aviation screening process had any effect on the rate of confiscated weapons at airport screening checkpoints.

Research Hypothesis

The hypothesis is that airport screening firearms confiscations (per one million screenings) were lower before the U.S. government (TSA) took over screening in 2001-2002.

Data Collection

Data collected from the Federal Aviation Administration (FAA) provided for a statistical analysis of confiscated firearms intercepted at airport screening/check points pre and post 9/11. The screening process prior to September 2001 was conducted by the private sector. After September 2001, the entire screening process was transferred over to the TSA. A rate was generated from the FAA's data that will provide a descriptive comparison of the number of firearms confiscated and the number of people screened

each year. A broad and extensive scope of sources were utilized in conducting this research to assist in forming clear and concise results. Existing research from academia, information from government reports, and data retrieved from various government agencies were also used in this study. Public records and publications from organizations, government agencies, and persons were examined. Data collected from the Federal Aviation Administration (FAA) provided for a descriptive analysis of confiscated firearms intercepted at airport screening check points.

Application of Time-Series Analysis

Celik, Corbacioglu, and Gumus (2008) performed a public policy analysis of gun control and crime. The study probed if the 1982 Chicago Gun Ordinance made any significant impact on violent crimes such as homicide and aggravated assault committed with firearms by using annual data between 1973 and 1999. Data was obtained from the U.S. Department of Justice, Bureau of Statistics, FBI uniform crime reports, and the Chicago Police Department for the city of Chicago. The study used Auto Regressive Moving Average time-series analysis along with a control group time-series analysis for the U.S. national level data.

The results of the study indicated that the policy decreased the homicide rates, although it was abrupt and only temporary. After the very first year, the policy affecting homicide rates was not statistically significant. The policy also did not decrease the aggravated assault crime at all after intervention. Celik's, Corbacioglu's, and Gumus's (2008) results indicate that the intervention year's significant negative effect on homicide rate is probably due to some other factors.

Data Analysis

This quantitative research required the performance of an interrupted time series analysis. A time series is a sequence of observations taken at evenly spaced time intervals (Yin, 2003). Time series analysis involves looking for patterns that will help us understand what is happening with the data (Berk, 2004). Interrupted time series analysis evaluates the impact of one or more events on the values in the time series. Within the same single case study, two different patterns of events may be hypothesized over time (Yin, 2003). Campbell (1969) utilized time series analysis in his study of the Connecticut speed limit law. One time-series pattern was based on the proposition that a new law (an interruption in the time series) had substantially reduced the number of fatalities, whereas the other time series pattern was based on the proposition that no such effect had occurred. Campbell's examination of the actual data points (the annual number of fatalities over a period of years) was used to determine which of the proposed time series patterns best matched the evidence.

An interrupted time series analysis attempts to determine whether an outside event affected subsequent observations. For an example, did the implementation of a new economic policy improve economic performance, did a new gun ordinance reduce violent crimes; or in this study, did the government takeover of airport screening increase the number of confiscated firearms. Such comparison of an "interrupted time series" within the same case has been applied to this study of firearm confiscations at airport checkpoints.

Although wanting to utilize data from all confiscations at airport screening checkpoints, this data is not available due to many factors. Before 2001, screening

services were used for the detection of metal objects. The FAA collected data on firearms, explosive and incendiary devices, and ‘other dangerous articles'. Firearms were divided into two subsections; handguns and long guns. The Office of Civil Aviation Security Policy and Planning discontinued keeping records of "other dangerous articles" in 1992 and explosive/incendiary devices recordkeeping was discontinued in 1994 due to inconsistent reporting (Bureau of Transportation Statistics, 2001).

Records of some intercepted items at airport screening checkpoints are not available for 2001 due to the inconsistent data most likely was contributed by the transition from private screeners to government screeners (Bureau of Transportation Statistics, 2001). Beginning in 2002, prohibited items began to include knives, box cutters, "other cutting instruments" clubs, and "other" in addition to firearms and incendiaries. As of August 8, 2008, the TSA stopped the collection of data on all prohibited items except for firearms and incendiaries (Bureau of Transportation Statistics, 2011).

Fluctuations in counts of prohibited categories can be attributed to changes in definitions and regulations governing prohibited items. Between 2005 and 2007 there was a large increase and then decrease of prohibited items due to the prohibition of lighters on board between April 2005 and August 2007 (Bureau of Transportation Statistics, 2011). Due to changes in definitions and regulations governing prohibited items over the last 30 years, the only consistent category of prohibited and confiscated items is firearms.

The FAA defines firearms as any weapon that is designed to or may readily be converted to expel a projectile by the action of an explosive, as well as spear guns, BB guns, flare pistols, compressed air guns, and stunning devices. It is important to keep in

mind that the airport screening checkpoint refers to the area in which passengers passed through with their carry-on baggage.

Prior to 2001, the general public was allowed into the terminal area as long as they passed through screening checkpoints. After 2001, only ticketed passengers were allowed into the terminal (sterile) area by passing through screening checkpoints. It is expected that the number of persons screened will be higher in the data collected before 2001 in comparison to the data of persons screened after 2001 due to the general public passing through security in addition to ticketed passengers. Following 2001, the persons screened included only enplanements or ticketed passengers in addition to a very small number of airport employees. Fortunately, this study looks at all persons screened and the number of firearms confiscated regardless of whether the person screened is a ticketed passenger or not.

Because the TSA was created in November 2001 but not fully implemented until November 2002, the 2001 and 2002 data of persons screened and confiscated firearms cannot be used due to this period of transition in which there was a presence of both TSA and private screeners in our nation's airports. Therefore, there are two data sets. The first data set includes persons screened and firearms confiscated from years 1990 through 2000. The second set of data includes persons screened and firearms confiscated from years 2003 through 2009. The total data that will be used spans a twenty year period (1990-2009).

Assumptions

It is assumed that the statistical and descriptive data retrieved from government reports including reports published by the FAA, TSA, and GAO is factual, nonpartisan, non-ideological, fair and accurate. Prior research used in this study is assumed to be truthful and accurate.

Limitations

Due to the numerous changes in what is defined as a prohibited and/or confiscated item as outlined by the FAA and TSA, there are inconsistencies in recordkeeping. There is very little information on screeners detecting prohibited items, as the federal government has classified the performance of both its screening workforce and detection equipment. The findings of this research may not be applicable to all airports.

Subjectivities or Bias

Having exposure and experience in both private sector and public sector security led me to explore my interest in differences between the two. This study originated as a study of the effectiveness between private and public security. This interest transformed into investigating the "poster child" of an industry's experience with both private and public security, the aviation industry. Civilian aviation screening is unique in that it transitioned from a private-performed operation to a government-performed operation in roughly one year. This is the single largest security transformation in the United States and has affected nearly everyone who has traveled. My curiosity to explore this issue has led me to the research at hand. By understanding and keeping my subjectivities in check, I researched this critical issue and provided objective information that can be used to positively impact aviation security.

Chapter 4

Research Findings and Analysis

Two groups of data represent the private and federal screening utilized over a twenty year span. Because the TSA was created in November 2001 but not fully implemented until November 2002, the 2001 and 2002 data of persons screened and confiscated firearms cannot be used due to this period of transition in which there was a presence of both federal (TSA) and private screeners in our nation's airports. Therefore, there are two data sets. The first data set includes persons screened and firearms confiscated from years 1990 through 2000 when private screeners were utilized. The second set of data includes persons screened and firearms confiscated from years 2003 through 2009 when federal screeners were utilized. The total data that will be used spans a twenty year period (1990-2009). Table 1 provides a visual representation of the two data groups.

Table 1.
Groups of Data

Years	Firearms Confiscated	Persons Screened
1990	2,549	1,145,000,000
1991	1,644	1,015,000,000
1992	2,608	1,111,000,000
1993	2,798	1,150,000,000
1994	2,994	1,261,000,000
1995	2,390	1,263,000,000
1996	2,155	1,497,000,000
1997	2,067	1,660,000,000
1998	1,515	1,667,000,000
1999	1,552	1,767,000,000
2000	1,937	1,812,000,000
2001	2001 & 2002 Screening Transition from Private to Federal. Data is excluded from study.	
2002		
2003	683	650,808,785
2004	650	706,424,048
2005	2,217	737,186,789
2006	2,075	739,308,556
2007	1,416	763,505,561
2008	902	736,470,443
2009	889	697,998,338

Group 1 (1990-2000) Private Screening Svc.

Group 2 (2003-2009) Federal Screening Svc.

Source(s): Research and Innovative Technology Administration (RITA) (2001). *Bureau of Transportation Statistics: Table 2-16: Airline Passenger Screening Results by Type of Weapons Detected, Persons Arrested, and Bomb Threats Received*. Retrieved March 17, 2011 from http://www.bts.gov/publications/national_transportation_statistics/2003/html/table_02_16.html
Research and Innovative Technology Administration (RITA) (2010). *Bureau of Transportation Statistics: Table 2-16: Prohibited Items Intercepted at Airport Screening Checkpoints*. Retrieved March 15, 2011 from http://www.bts.gov/publications/national_transportation_statistics/html/table_02_16.html.

Rate of Firearm Confiscations Per One Million Persons

A rate of persons screened and firearms confiscated was formulated that was used to compare each set of data. Due to the number of screened passengers being in the billions prior to 2001 and in the hundreds of millions after 2002, a rate of firearms confiscated per one million persons screened was calculated. To calculate this rate, the population (persons screened) was divided by one million to get "X." This means that there are X "groups" of one million persons screened in that population. The number of firearms confiscated was then be divided by X resulting in the number of firearms confiscated per one million persons. Below is a visual representation of the calculation.

Firearms Confiscated ÷ (Persons Screened ÷ 1,000,000) = Firearms Confiscated per One Million Persons

1990 Data:
2,549/(1,145,000,000/1,000,000) = 2.23 Firearms Confiscated per One Million Persons

Calculation breakdown:
1,145,000,000/1,000,000 = 1,145
2,549/1,145 = 2.23 Firearms Confiscated per One Million Persons

This calculation was performed for each year included in this study as exhibited in Table 2.

Table 2.
Firearms Confiscated per One Million Persons

Years	Firearms Confiscated	Persons Screened	Firearms per 1,000,000 Persons
1990	2,549	1,145,000,000	2.23
1991	1,644	1,015,000,000	1.62
1992	2,608	1,111,000,000	2.35
1993	2,798	1,150,000,000	2.43
1994	2,994	1,261,000,000	2.37
1995	2,390	1,263,000,000	1.89
1996	2,155	1,497,000,000	1.44
1997	2,067	1,660,000,000	1.25
1998	1,515	1,667,000,000	0.91
1999	1,552	1,767,000,000	0.88
2000	1,937	1,812,000,000	1.07
2001	2001 & 2002 Screening Transition from Private to Federal. Data is excluded from study.		
2002			
2003	683	650,808,785	1.05
2004	650	706,424,048	0.92
2005	2,217	737,186,789	3.01
2006	2,075	739,308,556	2.81
2007	1,416	763,505,561	1.85
2008	902	736,470,443	1.22
2009	889	697,998,338	1.27

Source(s): Research and Innovative Technology Administration (RITA) (2001). *Bureau of Transportation Statistics: Table 2-16: Airline Passenger Screening Results by Type of Weapons Detected, Persons Arrested, and Bomb Threats Received*. Retrieved March 17, 2011 from http://www.bts.gov/publications/national_transportation_statistics/2003/html/table_02_16.html
Research and Innovative Technology Administration (RITA) (2010). *Bureau of Transportation Statistics: Table 2-16: Prohibited Items Intercepted at Airport Screening Checkpoints*. Retrieved March 15, 2011 from http://www.bts.gov/publications/national_transportation_statistics/html/table_02_16.html.

Figure 1 provides a visual representation of the rate of firearms confiscated per one million screened plotted against time. The data thus far will be plotted against time to show trends, patterns, and outliers in firearm confiscations per million.

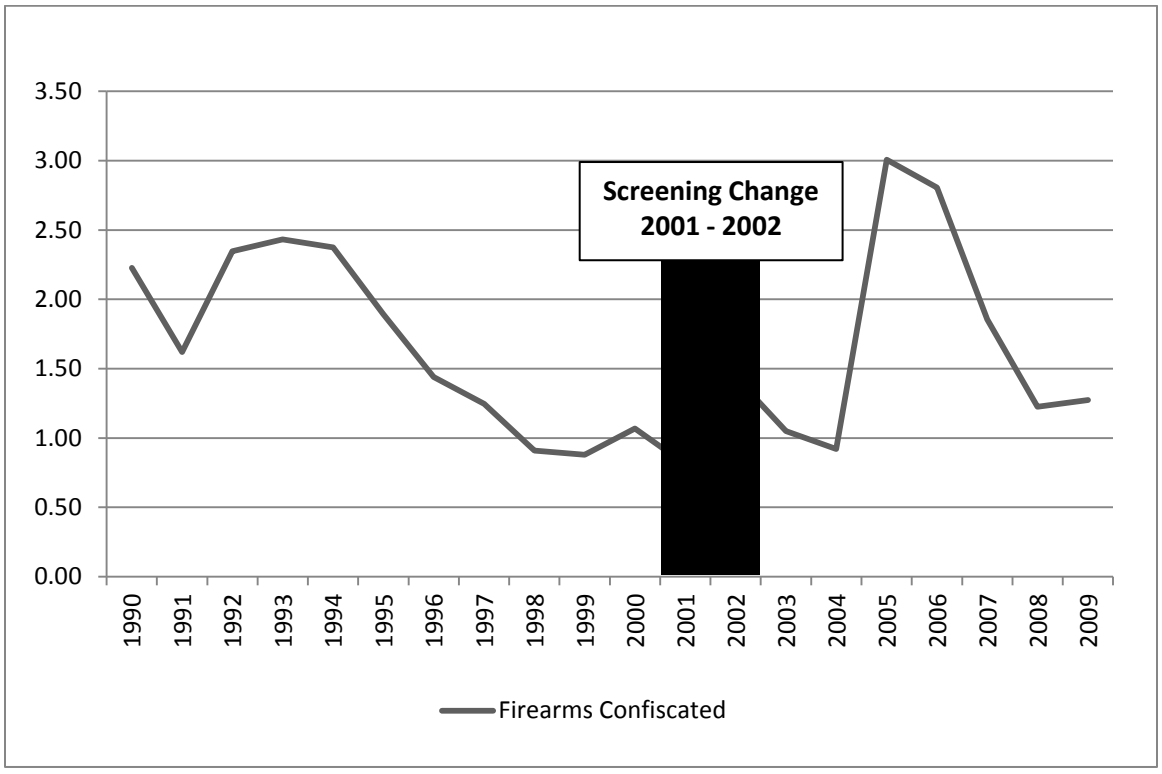

Figure 1. Rate of Firearms Confiscated Per One Million Screened

A noteworthy trend is the steady decrease in the rate of confiscated firearms from 1994 until 1999. This trend is within the first group of data when private screening services were being utilized. A startling observation is the sudden increase in firearm confiscations in 2005. Confiscations in 2006 dip slightly before lowering significantly in 2007 and even further in 2008. Confiscation levels in 2008 and 2009 using TSA screeners are at comparable levels to years 1998 – 2000 when private screeners were used. According to this graph, it is apparent that there is a significant difference in the rate of confiscations following the federalization of security screening. A time series analysis was conducted to test this observation.

Firearms Confiscated Averages

Descriptive statistics of the data were formulated to provide an in-depth analysis. The averages of the firearms confiscated per one million screened were found next. The average for all years (1990 through 2009, excluding 2001 and 2002) can be found by adding all eighteen years of firearms confiscated per one million persons together and dividing the sum by eighteen (eighteen total years of data). This calculation was performed as followed:

30.57 ÷ 18 = 1.70 Total Average Confiscated Firearms per million for 1990-2009 (Excluding 2001 & 2002).

Group 1 Average.

The average of the firearms confiscated per million screened for the first set of data (1990-2000) was found by adding the first eleven years together and dividing the sum by eleven (11 years of data). This calculation was performed as followed:

18.43 ÷ 11 = 1.68 Total Average Confiscated Firearms per million for Group 1 (1990-2000).

Group 2 Average.

The average of the firearms confiscated per million screened for the second set of data (2003-2009) was found by adding the last seven years together and dividing the sum by seven (7 years of data). This calculation was performed as followed:

12.14 ÷ 7 = 1.73 Total Average Confiscated Firearms per million for Group 2 (2003-2009).

The above calculations give us the averages of the data in three groups: total averages of all data (1990 through 2009, excluding 2001 and 2002), total averages of data

1990 through 2000, total averages of data 2003 through 2009. Table 3 and 4 provide a visual representation of the average number of confiscations for each group.

Table 3
Average Confiscated Firearms by Year

Group 1			Group 2	
Years	Firearms per 1,000,000 Persons		Years	Firearms per 1,000,000 Persons
1990	2.23		2003	1.05
1991	1.62		2004	0.92
1992	2.35		2005	3.01
1993	2.43		2006	2.81
1994	2.37		2007	1.85
1995	1.89		2008	1.22
1996	1.44		2009	1.27
1997	1.25			
1998	0.91			
1999	0.88			
2000	1.07			

Table 4
Average Confiscated Firearms by Group

Group	Total Data Points	Averages
All Years (1990-2009 excluding 2001 & 2002):	18	1.70
Group 1 Totals:	11	1.68
Group 2 Totals:	7	1.73

Yearly Change in Confiscated Firearms

Determining the yearly change in confiscated firearms is useful in determining if any trends exist or any possible outliers. To analyze change in the rate of confiscated firearms, the difference from year to year was calculated. This calculation was found by subtracting the current year from the preceding year; meaning Year 2 is subtracted from

Year 1. This calculation was performed for each year included in this study. Below is an example:

1991 rate of firearms confiscated per one million screened - 1990 rate of confiscated firearms per million = The rate change from 1990 to 1991.

1.62 - 2.23 = -0.61 Confiscated Firearms per Million.

Table 5 provides a visual representation of the yearly change of confiscated firearms per million for each data set.

Table 5
Yearly Change of Confiscated Firearms Per Million

Years	Firearms per 1,000,000 Persons	Diff. Per Year
1990	2.23	
1991	1.62	-0.61
1992	2.35	0.73
1993	2.43	0.09
1994	2.37	-0.06
1995	1.89	-0.48
1996	1.44	-0.45
1997	1.25	-0.19
1998	0.91	-0.34
1999	0.88	-0.03
2000	1.07	0.19
2001	2001 and 2002 Data Excluded	
2002		
2003	1.05	-0.39
2004	0.92	-0.13
2005	3.01	2.09
2006	2.81	-0.20
2007	1.85	-0.95
2008	1.22	-0.63
2009	1.27	0.05

When the yearly change of confiscated firearms per million is graphed against time, it allows us to provide a visual that is used to determine if any possible trends of outliers exist. Figure 2 displays this information.

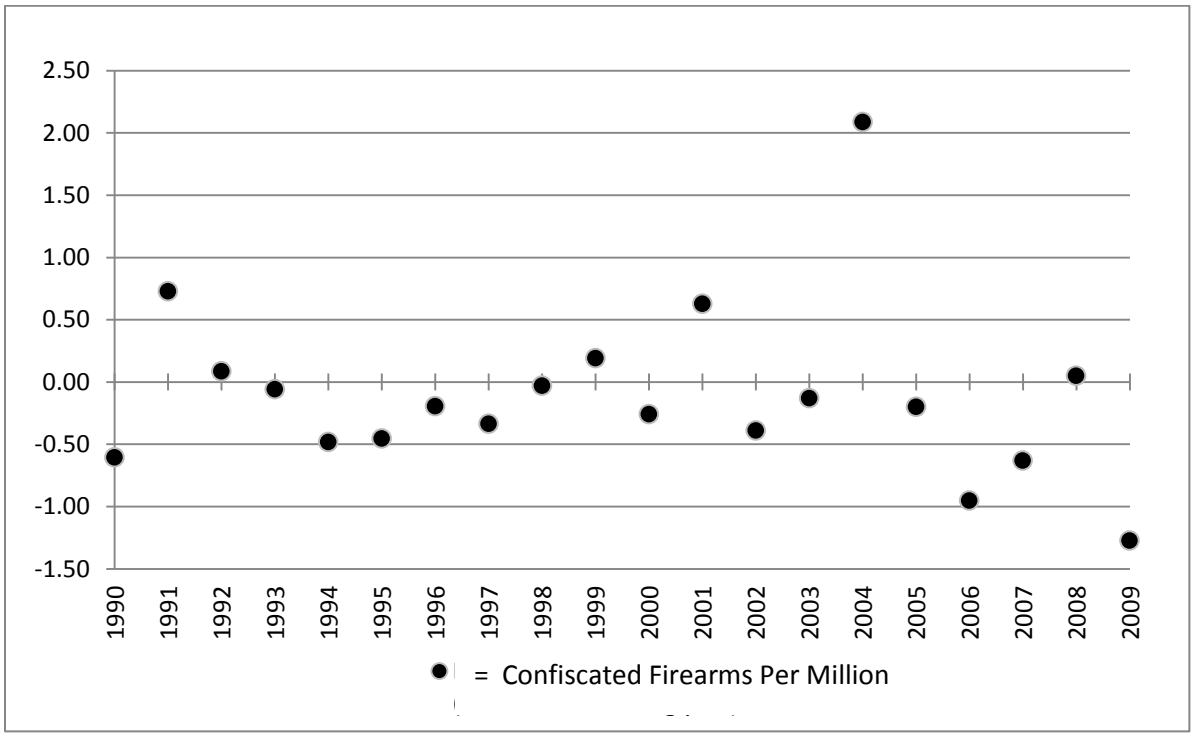

Figure 2. Yearly Change of Confiscated Firearms Per Million

When observing Graph 2, one possible outlier appears to be the difference from year 2004 to 2005. This significant change appears to be an anomaly as there is no justifiable reason for why this occurred.

Percentage Change in Confiscated Firearms

It is useful to determine the percentage change of the yearly rate of confiscated firearms. Determining the percentage change from year to year provides the reader with a better picture of any possible trends or major outliers. This was done by utilizing the results from the previous calculation. This calculation was performed by taking the

change in rate or difference per year of confiscated firearms divided by the same year's rate of confiscated firearms per million multiplied by one hundred.

Example:

(Confiscated Firearms Rate Change from 1990 to 1991 / 1990 Rate of Confiscated Firearms Per Million) x 100 = Percentage Change to the Following Year

(-0.61/ 2.23) x 100 = -27.35% change from 1990 to 1991

Table 6 provides a visual representation of the yearly percentage change of confiscated firearms per million for each data set.

Table 6
Yearly Percentage Change of Confiscated Firearms Per Million

Years	Firearms Per 1,000,000 Persons*	Difference Per Year*	Percentage Difference Per Year*
1990	2.23		
1991	1.62	-0.61	-27.24
1992	2.35	0.73	44.93
1993	2.43	0.09	3.65
1994	2.37	-0.06	-2.41
1995	1.89	-0.48	-20.30
1996	1.44	-0.45	-23.93
1997	1.25	-0.19	-13.50
1998	0.91	-0.34	-27.01
1999	0.88	-0.03	-3.36
2000	1.07	0.19	21.71
2001	0.81	-0.26	-24.10
2002	1.44	0.63	77.47
2003	1.05	-0.39	-27.12
2004	0.92	-0.13	-12.32
2005	3.01	2.09	226.84
2006	2.81	-0.20	-6.67
2007	1.85	-0.95	-33.92
2008	1.22	-0.63	-33.96
2009	1.27	0.05	3.99

* Figures are rounded to two decimal places.

Figure 3 provides a visual representation of the percentage difference per year of confiscated firearms per million for each data set.

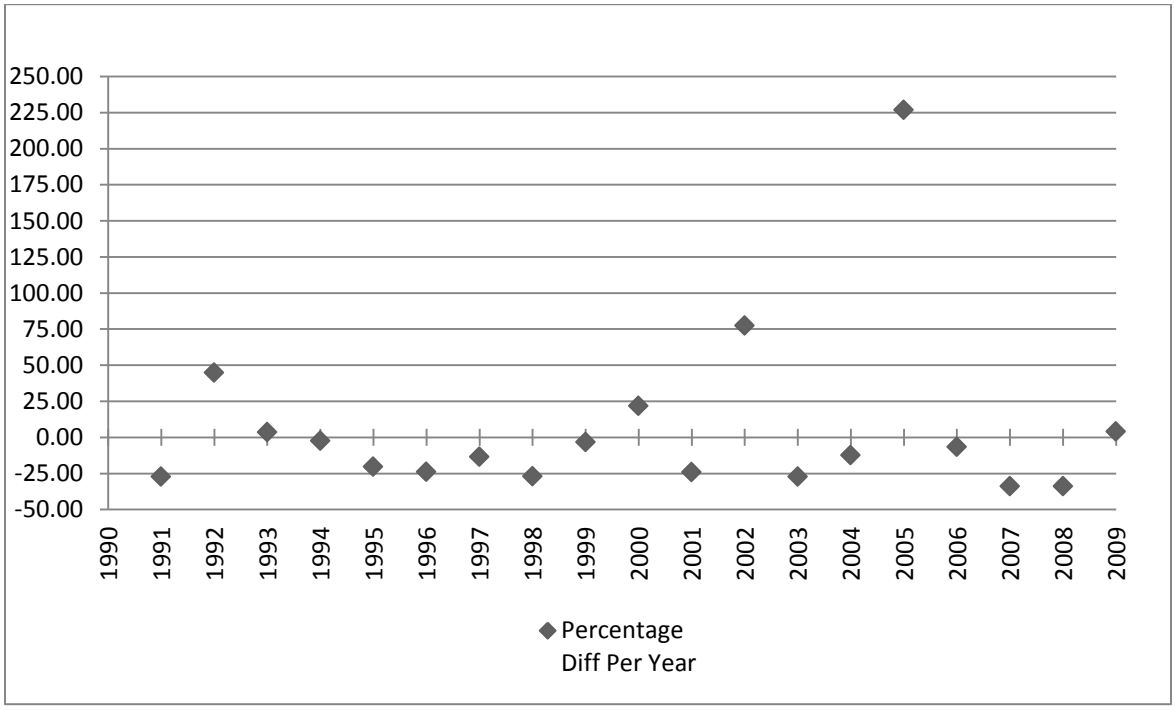

Figure 3. Yearly Percentage Change of Confiscated Firearms Per Million

Hypothesis Test

The null hypothesis is often rejected when the p-value is less than or equal to the significance level. When the null hypothesis is rejected, the result is statistically significant. A result is considered statistically significant if it is unlikely to have occurred by chance. Results that are statistically insignificant mean the results are likely to be due to chance.

A null hypothesis is used in statistics that proposes that no statistical significance exists in a set of given observations. If the results of the test equal zero, there is no significant difference found between the first group of data (1990-2000 firearm confiscations per million) and second group of data (2002-2009 firearms confiscated per million).

The null hypothesis is as follows:

H_0: $u_1 - u_2 = 0$

If the results are less than zero then this indicates that confiscations before the government takeover were lower.

H_1: $u_1 - u_2 < 0$

Degrees of Freedom

The degrees of freedom is the number of independent pieces of data that are used to make a calculation. The degrees of freedom were calculated by taking the total units and subtracting the number of groups of data.

$(N_1 + N_2)$ - Number of Groups = Degrees of Freedom

$(11 + 7) - 2 = 16$

Degrees of freedom = 16

Critical Value

The critical value represents a number that must be achieved in order to demonstrate statistical significance. The critical value was obtained from a t-Distribution Probability Table using a one-tailed test at a significance level of 0.05 and the number of degrees of freedom (16). A significance level of 0.05 is used because it is universally accepted as the value for statistical significance. From the t-Distribution Probability Table we can see that the critical value is 1.746.

Determining Variance

Variance states how close together the numbers in a group are. The variance was found for both groups of data (Group 1 and Group 2). The following is the formula for variance:

$$s^2 = \frac{\sum (X - \bar{X})^2}{n-1}$$

X-line is the average for the group of data.

n is the sample size for the group.

$(X_i - \overline{X})$ means that every number in the group must be subtracted by the average for the data set.

The resulting figures must then be squared before being added together.

The sum of squared numbers will then be divided by (n-1)

The following formula was used to calculate the variance ("s") that will later be used in the t-test.

$$s^2 = \frac{(N_1 - 1)(S_1)^2 + (N_2 - 1)(S_2)^2}{N_1 + N_2 - 2}$$

Group 1 (1990-2000) is the years when private screening services were utilized.

N_1 is the number of years in the Group 1 data set; 11.

Y_1 is the average firearms confiscated per million for first data set (1990 through 2000); 1.68. This was determined earlier in the Firearm Confiscations for Group 1 section.

S_1 is the variance for the first data set of firearms confiscated per million

Years following the government take over include 2003-2009

N_2 is the number of years following the government takeover

Y_2 is the average firearms confiscated per million for second data set (2003 through 2009)

S_2 is the variance for the second data set of firearms confiscated per million

T-Test Calculation

The results in the above calculations were utilized to conduct a t-test. A t-test assesses whether the means of two groups are statistically significant from each other. The T-test tested my hypothesis of airport screening firearm confiscations per one million screenings were lower before the U.S. government (TSA) took over screening in 2001-2002.

$$s^2 = \frac{(N_1 - 1)(S_1)^2 + (N_2 - 1)(S_2)^2}{N_1 + N_2 - 2}$$

Years prior to the government takeover include 1990-2000.

N_1 is the number of years prior to government takeover

Y_1 is the average firearms confiscated per million for first data set (1990 through 2000)

S_1 is the variance for the first data set of firearms confiscated per million

Years following the government take over include 2003-2009

N_2 is the number of years following the government takeover

Y_2 is the average firearms confiscated per million for second data set (2003 through 2009)

S_2 is the variance for the second data set of firearms confiscated per million

The formula below was used to calculate the variance ("s") is later used in the t-value test statistic.

$$s = \sqrt{\frac{(11 - 1)(0.370)^2 + (7 - 1)(0.731)^2}{11 + 7 - 2}}$$

$s = 0.5347$

T-Value Test Statistic

T-Value: $$\frac{Y_1 - Y_2}{s\sqrt{(1/N_1) + (1/N_2)}}$$

Y_1 is the average firearms confiscated per million for first data set (1990 through 2000)

Y_2 is the average firearms confiscated per million for second data set (2003 through 2009)

N_1 is the number of years prior to government takeover

N_2 is the number of years following the government takeover

s is the variance (0.5347).

T-Value: $$\frac{1.68 - 1.73}{s\sqrt{(1/11) + (1/7)}}$$

T-Value: $$\frac{-0.05}{0.258}$$

T-Value: -0.194

Since the critical value equals 1.746 and the test statistic is lower (-0.194), we cannot reject the null hypothesis (Ho). Since we do not reject the null hypothesis (H_0) we assume H_0: $u_1 - u_2 = 0$. This means the two samples come from a population with the same mean (u). Since the samples have the same mean (u), this means there are no differences between the two sets of data since the results are significant at 0.05. This means, according to the results of the t-test, there is no significant difference between the number of firearm confiscations by private screeners and the number of firearms confiscated by government screeners. This indicates that the transition from private to public screeners has had no statistically significant effect on the number of firearm confiscations.

To be able to further understand the results of this study, it is necessary to examine the theoretical screening process models used by the private sector before 9/11 and by the TSA after 9/11. Two models have been developed that depict security checkpoint screening for weapons. The first model is a depiction of security checkpoint screening used in 2001 when screening services were conducted by private organizations. The second model is a depiction of the current security checkpoint screening model used by the Transportation Security Administration.

2001 Theoretical Screening Process Model (Private Screening Model)

Prior to the federalization of security screening, screening was the responsibility of individual airlines and aircraft operators. Security screening was usually subcontracted to an approved vendor, often by selecting the lowest bid. The general public along with passengers were allowed into the terminal area as long as they passed through screening checkpoints. A passenger's travel documentation was checked at their departing gate by airline staff. Figure 4 illustrates the screening processes that takes place from when an individual makes a flight reservation to when they pass through security checkpoint screening.

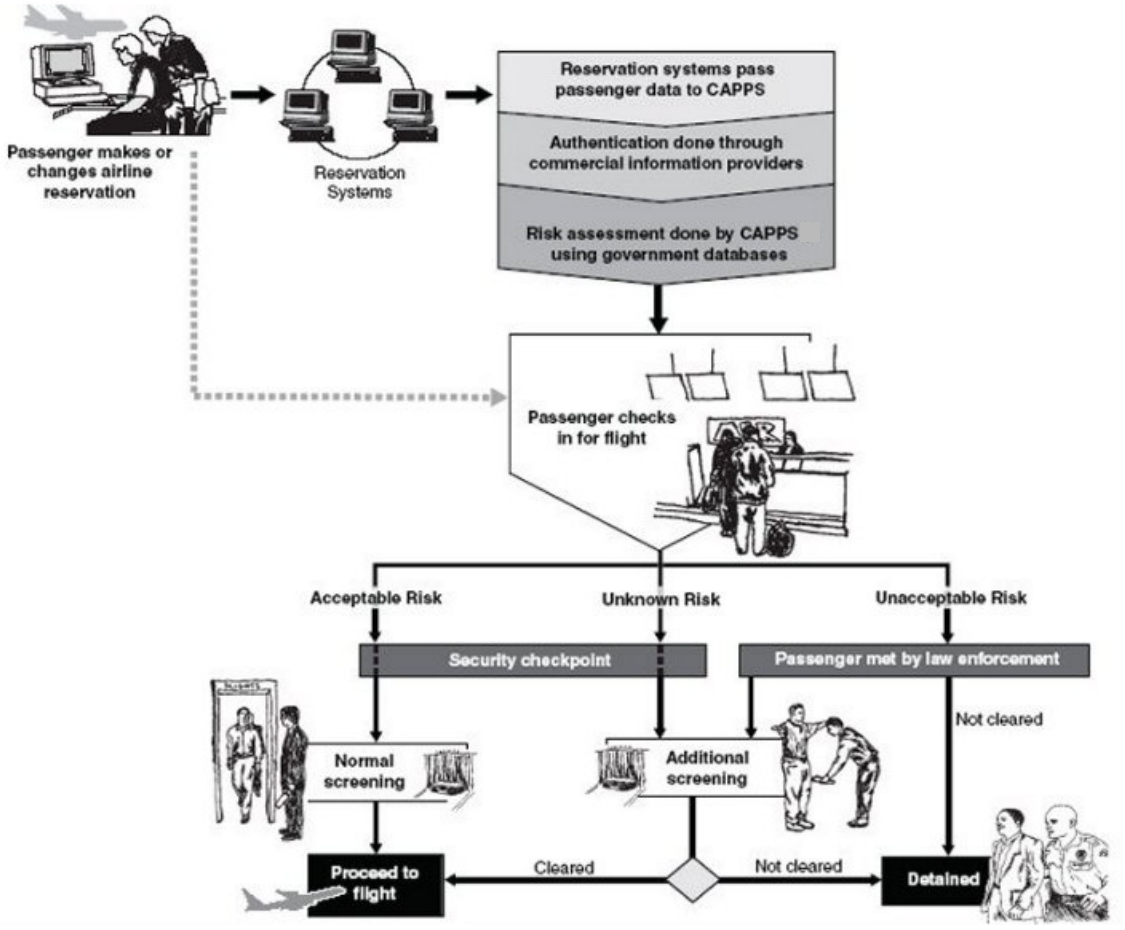

Figure 4. 2001 Screening process passenger flow prior to federalization.

Source(s): GlobalSecurity.org (2007). *Homeland Security: Computer Assisted Passenger Prescreening Program*. Retrieved from March 3, 2012 from http://www.globalsecurity.org/security/systems/cappsii.htm

The theoretical process model used in the 2001 checkpoint screening of passengers and accessible property (Private Screening Process Model) is broken into several phases. Each phase is explained in detail.

1. The individual loads their belongings onto the conveyer for analysis by an X-ray machine.

2. The individual is requested to move through a walk through metal detector (WTMD). A WTMD creates a magnetic field which is disrupted by the presence of metal. If the

disruption is high enough, an alarm will sound. Individuals who set off the detector's alarm are asked to step aside until a secondary search can be conducted, usually consisting of a hand wand or hand held metal detector (HHMD). In some instances, individuals may be allowed to go back through the metal detector after divesting themselves of additional items that may have triggered the alarm, rather than going to secondary screening. Individuals in wheel chairs or with casts and prosthetic devices were screened via the hand wand metal detector were subject to pat downs.

3. As the individual is being screened, security staff members analyze the contents of the individual's bag and belongings using conventional X-ray technology.

4. Baggage that contains questionable items or threat items is often checked physically through a bag search, analysis of an explosive trace detection (ETD) machine, or in some cases, both. If a bag contains an apparent bomb, then the screener would keep the suspect item within the X-ray machine, stop the belt to prevent the bag from advancing out of the machine, and hinder attempts by the owner to pull the bag away from the security staff. The screener will notify law enforcement and supervisory personnel for further assessment of the X-ray image.

5. Exit process. Provided that the belongings have been cleared through the X-ray analysis, individuals are reunited with their belongings and allowed to proceed into the terminal(s).

This process is depicted graphically in Figure 5.

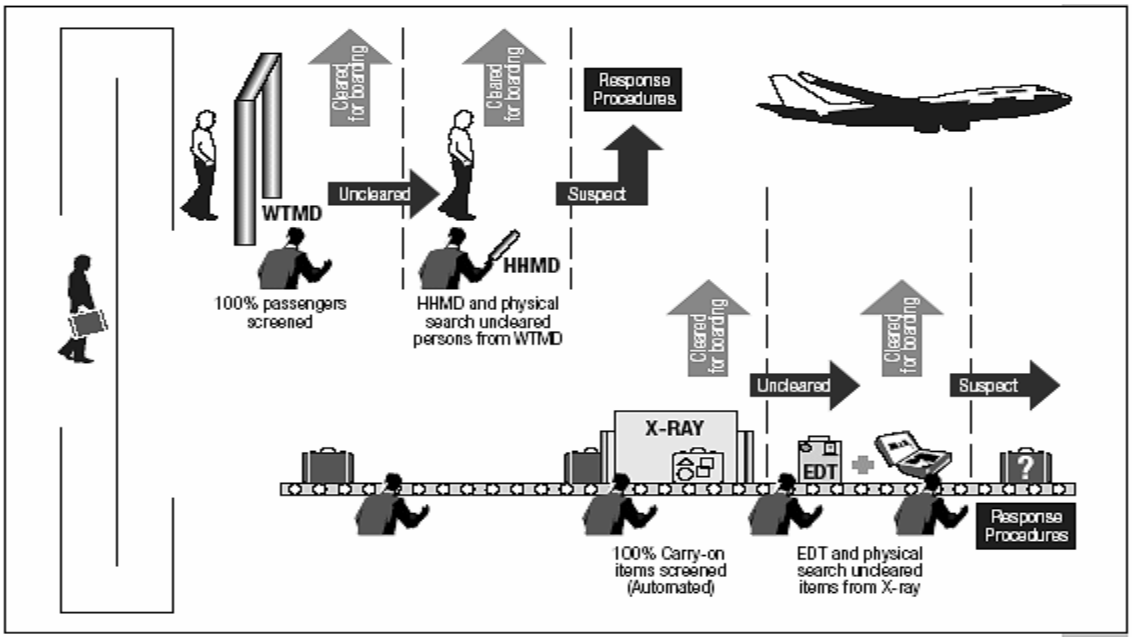

Figure 5. Theoretical process model used in the 2001 checkpoint screening of passengers and accessible property (Private Screening Process Model).

Source(s): Transport Canada (2006). *CATSA's Mandate: Chapter 3: Multi-stage Process for Pre-board Screening.* Retrieved March 20, 2012 from http://www.tc.gc .ca/tcss/catsa/final_report-rapport_final/chapter3_e.htm

Prohibited items were limited to explosive and incendiary devices, firearms, and knives four inches or longer in length. FAA policy allowed passengers to carry knives that were shorter than 4 inches onboard. It was assumed that individuals attempting to conceal a bomb would be deterred by the WTMD. The belief was that metal detectors would always detect metal components within the bomb. It was assumed that an individual attempting to conceal a bomb in their baggage would be detected by the X-ray operator. Conventional X-ray machines used at the time did not have the capabilities to detect trace explosive material. Explosive detection system technology and explosive trace detection technology was deployed to the nation's commercial airports with the intent of using them on travelers who were selected under the Computer-Assisted

Passenger Profiling Program (CAPPS) or were selected for secondary screening. These machines were rarely used as few individuals were flagged under the CAPPS program.

Current Theoretical Screening Process Model (TSA Screening Model)

The Department of Homeland Security currently utilizes 20 layers of screening in its aviation security model (Figure 6). These 20 layers can be grouped into categories based on location in the security process. According to Feltcher (2011), categories include 1) intelligence; 2) checkpoint screening of passengers and accessible property; 3) checked-baggage screening; 4) random security measures; and 5) security measures on board the aircraft.

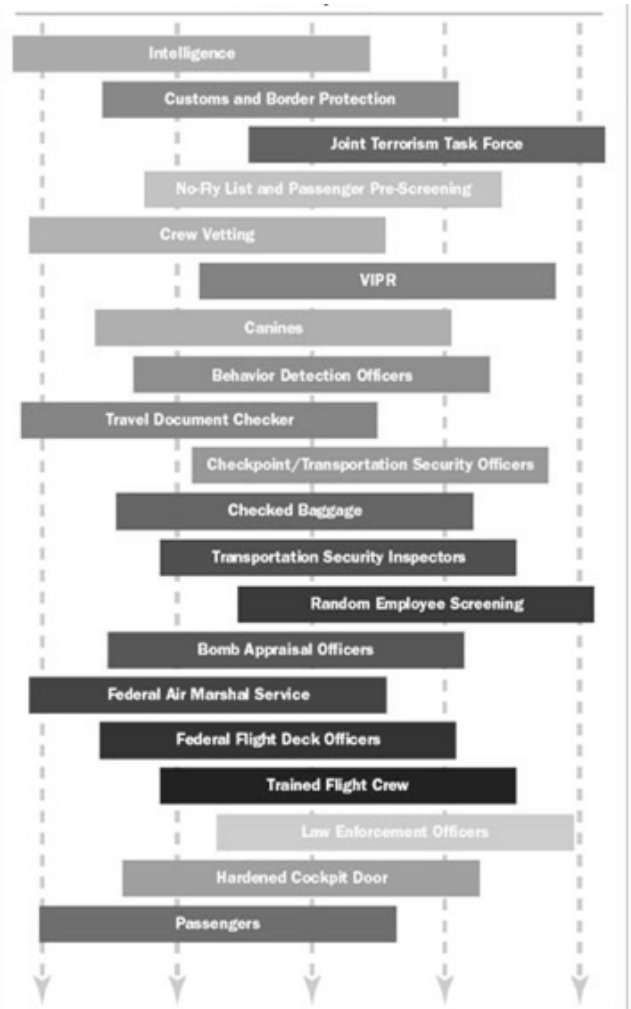

Figure 6. Layers of U.S. Aviation Security

Source(s): Transportation Security Administration (2012). Layers of Security. Retrieved March 15, 2012 from http://www.tsa.gov/what_we_do/layers/index.shtm

Visible Intermodal Prevention and Response (VIPR) teams are comprised of federal air marshals, surface transportation security inspectors, transportation security officers, behavior detection officers and explosives detection canine teams. According to the TSA, VIPR teams work with local security and law enforcement officials to supplement existing security

resources, provide deterrent presence and detection capabilities, and introduce an element of unpredictability to disrupt potential terrorist planning activities. VIPR teams are typically involved in rail sector and ferry operations to provide additional security.

Behavioral Detection Officers (BDO) utilize behavioral observation and techniques to analyze and identify potentially high risk passengers. BDOs screen travelers for involuntary physical and physiological reactions that people exhibit in response to a fear of being discovered.

TSA's Secure Flight program encompasses multiple layers of security screening. Specifically in the pre-screening areas. Secure Flight requires passengers to provide certain personal information during the flight reservation process. This information is ran against existing No-Fly lists and other data systems to identify suspected terrorists. This information is then used by TSA and law enforcement to facilitate the travel of legitimate passengers and enhance security for suspect individuals.

Federal Air Marshals is a system that has been in place since 1962 that is composed of Federal law enforcement officers under the TSA. Air Marshals deploy onboard select flights to detect, deter and defeat hostile acts while blending in with other passengers.

The Federal Flight Deck Officer program authorizes eligible flight crewmembers to use firearms to defend against an act of criminal violence if an attempt is made to take control of an aircraft. Authorization by the TSA is given to select pilots and flight engineers and these personnel are trained by the Federal Air Marshal Service.

Airport screening checkpoints operated by Transportation Security Officers are the one layer that is commonly associated with the TSA because of its visibility to the public. Due to this study's focus on firearm confiscations at passenger screening checkpoints, the theoretical model used for the checkpoint screening of passengers and accessible property layer of screening will be examined. After 2001, only ticketed passengers were allowed into the sterile (terminal) area by passing through screening checkpoints. The various security measures used in the current model to screen passengers and their property are shown in Figure 7.

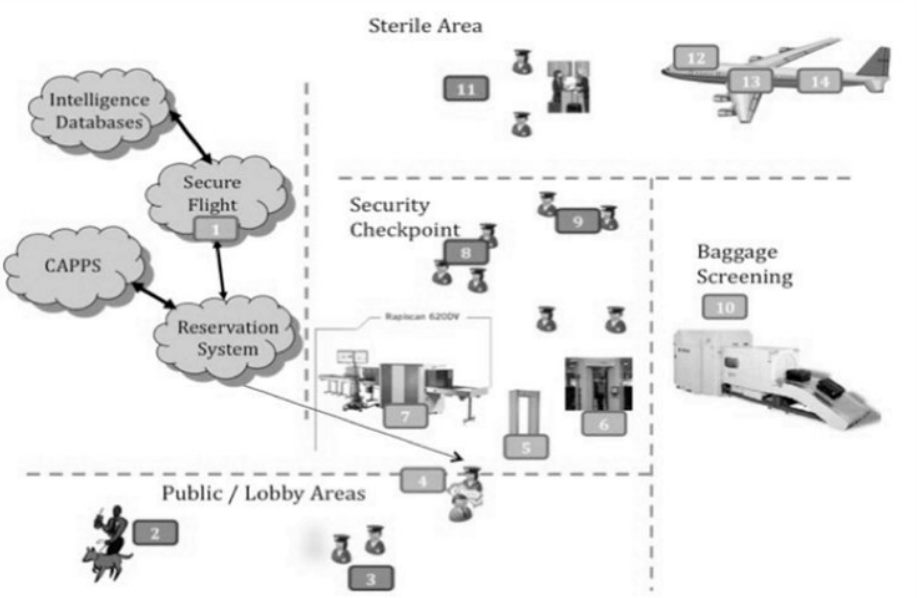

Figure 7. Current Screening Process Model (TSA Screening Model).

Source(s): Fletcher, Kenneth C. (2011). *Aviation Security: A Case for Risk-Based Passenger Screening.* (Masters thesis, Naval Postgraduate School, 2011). Retrieved from http://edocs.nps.edu/npspubs/scholarly/theses/2011/December/11Dec_Fletcher.pdf

The theoretical process model used in the current checkpoint screening of passengers and accessible property is broken into several phases. Each phase is explained in detail.

1. Travel Document Checking Station. Travel Document Checkers position in front of the checkpoint to check passengers' boarding identification. This was a responsibility was assumed by TSA from airline contractors. This layer discovers suspect, illegal or expired documents, passports, visas, and drivers licenses.

2. The passenger or employee is called by security staff to remove outer attire and anything that may set off the metal detector, such as belt buckles, watches, jewelry, coins, mobile phones, or PDAs. These items are placed in a polymer container and sent through the X-ray machine. Laptop computers and personal DVD players are removed from their containers and placed in separate bins. Liquids and gels must be removed from baggage to provide an unobstructed view of the contents. Individuals must also remove their shoes. The individual also loads their baggage onto the conveyer for analysis by the X-ray machine.

3. The passenger is requested to move through a walk through metal detector (WTMD). A WTMD creates a magnetic field which is disrupted by the presence of metal. If the disruption is high enough, an alarm will sound. Passengers who set off the detector's alarm are asked to step aside until a secondary search can be conducted, usually consisting of a pat-down or hand wand metal detector. In some instances, passengers may be allowed to go back through the metal detector after divesting themselves of additional items that may have triggered the alarm.

4. The passenger is moved into an Advanced Imaging Technology(AIT) device. Typically, these are whole body imaging millimeter wave portals that scan the body for both metallic and non-metallic items. The most noticeable and most controversial

screening technology is the use of Advanced Imaging Technology. TSA began deploying AIT in airports around the country in 2007. Two types of imaging technology are used; millimeter wave and backscatter. Backscatter technology projects X-rays over the body to create a reflection of the body displayed on a monitor. Images are viewed in a remote location. The imagery produced is very detailed and shows the body contours of the individual being screened. Millimeter wave technology sends electromagnetic waves to through the scanner. When the waves reflect off of the person inside the unit, an image is projected on a screen. Potential threats are highlighted on a generic outline of a person for every passenger on a screen immediately outside of the device. This eliminates the need for officers to remotely view images. Passengers selected for AIT screening who object to proceeding through this screening will be subject to equivalent alternative screening including physical pat down.

3. Carry-on baggage screening. As the passenger is being screened, security staff members analyze the contents of the passenger's belongings using conventional X-ray technology or explosive detection system (EDS) technology. Baggage that contains questionable items or threat items is often checked physically through a bag search, analysis of an explosive trace detection (ETD) machine, or in some cases, both. If a bag contains an apparent bomb, then the screener will likely keep the suspect item within the X-ray machine, stop the belt to prevent the bag from advancing out of the machine, and hinder attempts by the owner to pull the bag away from the security staff. The screener will notify law enforcement and supervisory personnel for further assessment of the X-ray image.

4. Exit process. Provided passenger belongings have been cleared through the X-ray analysis, the passengers are reunited with their belongings and allowed to proceed into the sterile area.

5. Special circumstances. Disabled passengers and those in wheelchairs often must be hand searched. Cast Scopes are used for screening casts and prosthetic devices to ensure they are not concealing weapons or explosives. Bottle liquids scanner (BLS) screening systems are used by TSA agents to detect liquids or gels that may be a threat to security. BLSs are used primarily to screen medically necessary liquids in quantities larger than three ounces.

This process is depicted graphically in Figure 8.

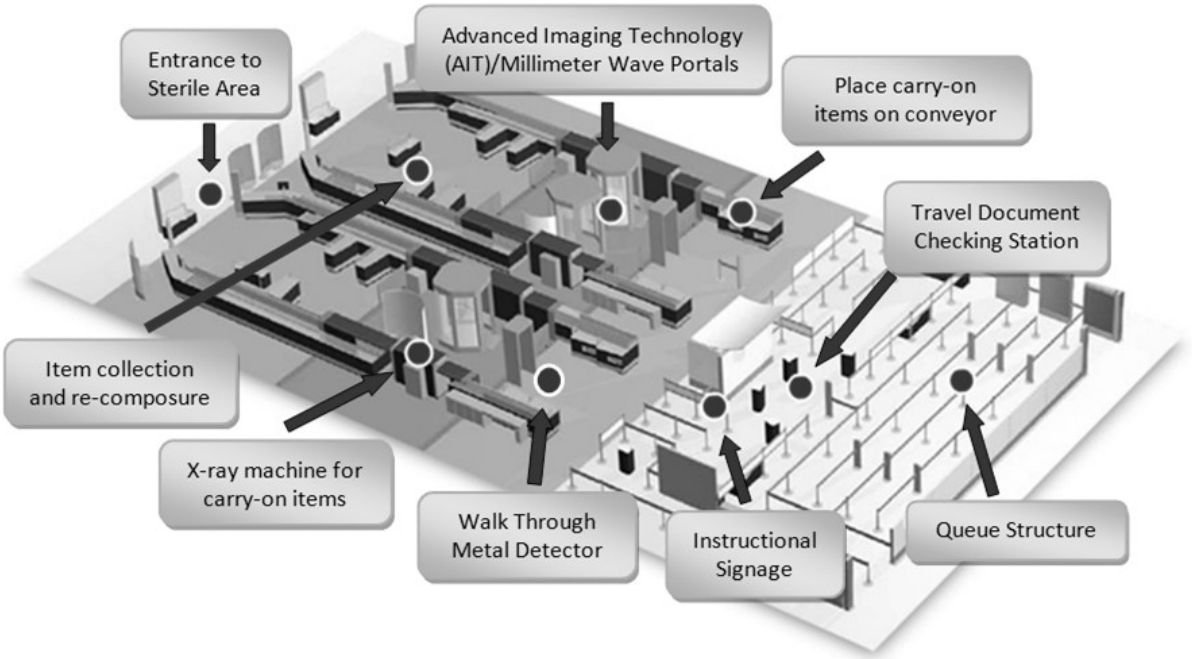

Figure 8. Current screening checkpoint process model of passengers and accessible property (TSA Screening Process Model).

Source(s)**:** Transportation Security Administration (2012) *Checkpoint Evolution*. Retrieved March 13, 2012 fromhttp://www.tsa.gov/what_we_do/layers/index.shtm

The list of prohibited items grew exponentially since the federalization of security checkpoint screening. Sharp objects, sporting goods, guns and firearms, tools, martial arts and self defense items, explosive and flammable materials, chemicals and several other items have been prohibited with few exceptions. The most significant change was the limitation on liquids and gels to 3.4 ounces or less and may have no more than what will fit in a quart size clear plastic bag.

Theoretical Process Model Comparative Analysis

The more significant changes between the two theoretical models are the increase in types of prohibited items and advancement of security technology used for the detection of potential explosive or incendiary devices. Upon examination of both theoretical screening process models it becomes apparent as to why the data has shown there is no significant difference in firearm confiscations. The processes utilized in screening for firearms are nearly identical between the private and public models. The two primary screening technologies used to screen for firearms are walk through metal detectors and the use of x-ray machines for screening carry-on baggage. The standard method of screening in the United States is the use of walk through metal detectors (WTMD) or often called magnetometers. A WTMD creates a magnetic field which is disrupted by the presence of metal. If the disruption is high enough, an alarm will sound. The specific level required to sound an alarm can be set depending on the sensitivity desired. WTMDs only require a few seconds to detect metal found on an individual, so passengers can be quickly processed. Although advancements in technology have improved some security equipment and led to the development of new technology and screening processes, the technology and functionality of walk through metal detectors

used at screening checkpoints have remained relatively the same since their inception in the 1960s. Since all firearms have metal components, the technology used in screening and detecting firearms have remained unchanged for 40 years.

X-ray machines used to screen objects non-invasively for potential threats have also remain relatively unchanged. The primary parts of luggage x-ray inspection systems include the generator which generates x-rays, the detector to detect radiation after it has passed through the baggage, the processing unit or computer, and the conveyor system for moving the baggage into the system. The signal processing system processes the amount of radiation transmitted back to the machine from the baggage and produces an image based upon the type of material and density of the object. Modern X-ray machines have the capability to display images in three colors; blue, orange, and green. Objects displayed in blue are typically hard materials such as hard plastic or metal. Objects displayed in green are plastics and alloys where the density isn't enough to make it blue or black. Objects displayed in orange are biological materials which include all liquids and gels, and other explosive or incendiary materials. The ability to identify objects based upon their consistency and color displayed by the machine assists screeners in identifying potentially harmful liquids and explosives. The concept of identifying and locating the outline of prohibited items such as knives and firearms has remained consistent since the application of x-ray machines into security screening.

Chapter 5

Discussions and Implications

This research has provided a brief glimpse into assessing civilian aviation screening. The question this research sought to answer was:

- Has the federalization of airport screening in 2001-2002 increased the number of firearm confiscations at screening checkpoints?

Answers to these questions can be found within the construct of the research findings. Two major findings have been exposed during this research: (1) there is an extremely limited amount of confiscation data available to the public due to either inconsistencies in recordkeeping or information that is classified and (2) there is no significant difference in the level of firearm confiscations after the federalization of the civilian aviation screening process. When screening for firearms, there has been no significant difference in confiscation levels since the federalization of civilian aviation screening. Inconsistencies in record keeping and confidentiality of screening data limit the availability of research that can be conducted by the general public. These limitations are due to numerous changes in what is defined as a prohibited and/or confiscated item as outlined by the FAA and TSA. There is very little information on screeners detecting prohibited items, as the federal government has classified the performance of both its screening workforce and detection equipment.

The technology of X-ray machines and magnetometers have remained consistent over the period of time encompassing both groups of data. This disproves the argument that advances in screening technology have had an effect on the number firearms

confiscated. We can assume that, although two different groups of people and processes are bring performed, the same results are likely to occur. This reinforces the theory that it doesn't matter if the person operating the X-ray machine or running the metal detector is a TSA employee of an employee of a private security contractor, the results of firearms confiscated are likely to be consistent.

There is no statistically significant difference in the number of firearms confiscated between the two groups of data (private and public) at a significance level of 0.05. The increase in the number security personnel, improved technology and vast increase in resources have led to no significant difference in the number of confiscated firearms at airport screening checkpoints. The results of this study do not mean that both private and public screeners are equally effective in their screening process nor does it say that there is not a difference in firearm confiscations between the two groups. This does not mean that either private or public sector screening services are more effective than its counterpart, but rather they are equal in the number of confiscations at the significance level of 0.05. The results of the t-test were calculated manually and later confirmed using the Statistical Package for Social Science (SPSS).

Future Research

The private versus public security debate will continue to be a heated topic among industry professionals for years to come. The screening process will continue to evolve as technology advances and the national security landscape transforms. The emerging threat of plastic explosives allow for extensive research opportunities in the development of state of the art screening technology. Research on the availability of confiscation data and how data is collected by screeners and TSA personnel can help in the accuracy of

information and may lead to more accurate predictive analysis. Performing this same study with data of other confiscated items such as explosive devices and knives can draw a more accurate comparison between private and public security screening. Performing research at the local or regional level may provide more accurate results that may be applicable to airports considering public or contract security services.

Research can be conducted on creating an ideal model of the civilian aviation security screening process. This research can look at the processes involved in screening, the types of technology used during the screening process, the type of staff and training each screener must complete. Upon studying various screening methods used by private and public screeners developing a model that can be considered to the ideal model may be advantageous towards bettering aviation security.

Summary

The large number of people utilizing airports every day as their means of travel provides for a hot terrorist target. Terrorist and criminal activity in the aviation industry is not a new issue but has recently been highlighted here in the United States by the September 2001 attacks. These attacks proved that increased security measures were needed. The federalization of civilian aviation screening brought about the largest government assumption of a previously private function in U.S. history. Thousands of new jobs were created and billions of dollars in taxpayer funding were provided to improve technology and the aviation screener. This study set out to determine if the federalization of the screening process had any effect on the number of firearm confiscations. Due to limited publically available data and inconsistencies in data collection, firearms were the only category of confiscations available that provided

sufficient data points (years of data) to conduct quantitative research. A study comparing the theoretical screening process model used by the private sector and the process model currently in use by the TSA was performed to determine if any technological advances may have had an effect on the statistical results.

This quantitative research required the performance of an interrupted time series analysis. Interrupted time series analysis evaluates the impact of one or more events on the values in the time series. An interrupted time series analysis attempts to determine whether an outside event affected subsequent observations. For an example, did the implementation of a new economic policy improve economic performance, did a new gun ordinance reduce violent crimes; or in this study, did the federalization of civilian airport screening increase the number of confiscated firearms. Such comparison of an "interrupted time series" was applied to this study of firearm confiscations at airport checkpoints.

Because the TSA was created in November 2001 but not fully implemented until November 2002, the 2001 and 2002 data of persons screened and confiscated firearms was not used due to this period of transition in which there was a presence of both TSA and private screeners in our nation's airports. Therefore, there were two data sets. The first data set includes persons screened and firearms confiscated from years 1990 through 2000. The second set of data includes persons screened and firearms confiscated from years 2003 through 2009. The total data that was used spans a twenty year period (1990-2009).

The results of the t-test concluded that there was no significant difference between the number of firearm confiscations by private screeners and the number of firearms

confiscated by government screeners. This indicated that the transition from private to public screeners has had no effect on the number of firearm confiscations.

Future research can be utilized to further explore this critical area that impacts anyone who travels by plane. Areas to be explored can include data collection methods, civilian aviation screening models, and screening personnel comparisons at the local or regional level. Due to the enormous amount of resources that are spent on aviation security in our country, there is a clear need to develop the most effective and efficient ways to keep our skies and airports safe and secure. Providing quality information to our leaders and policy-makers is essential to make more effective decisions on aviation security and to continually improve our screening models and methods.

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