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Airport security screening and changing passenger satisfaction: An exploratory assessment

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Abstract

Since September 11, 2001, airport screening procedures in the US have been continuously evolving. For example, the passenger screening process is now trying to strike a balance between security and customer service (i.e. minimizing wait times). This balancing act has important implications not only for passenger safety, but also for the financial stability of an airline industry that is faced with volatile energy prices and sometimes burdensome labor agreements. Using data from 2002 and 2003, we estimate multinomial logit models to uncover factors that determine passenger satisfaction at security screening points. Our findings show that, while wait times at security screening points are significant determinants of passenger satisfaction, many other factors come into play. Moreover, the results show that the determinants of customer satisfaction are not stable over time. This suggests that further refinements in airport screening procedures should give careful consideration to the factors underlying passenger satisfaction, and how these might change over time, rather than focusing exclusively on minimizing wait times at passenger screening points.

Keywords: Airport security; Airline passenger satisfaction

1. Introduction

Since the events of September 11, 2001, US airport screening procedures have undergone significant changes to ensure passenger safety. These changes have been managed by the Transportation Security Administration (TSA), which was created in November 2001 with a charge to improve and federalize airport security at 429 commercial airports (Aviation and Transportation Security Act, 2001). Since implementation, a key component of the increased security effort has been improvements in passenger screening procedures. Evaluations of the new passenger screening procedures implemented by the TSA have focused on passenger-screener training and the success of new procedures in identifying potential threats (US General Accounting Office, 2003; Jacobson et al., 2001; Virta et al., 2002). While these evaluations have identified various successes and failures—there is one undeniable fact: passenger costs, in terms of time and inconvenience, have increased dramatically as the result of intensified passenger screening procedures (Coughlin et al., 2002). Current screening procedures require passengers to arrive early, can expose them to long delays at screening points and, in some extreme cases, force them to experience airport closures. As a case in point, as recently as August 2005, Portland International Airport was closed when two passengers breached the security checkpoint.

The growth in passenger delay has not gone unnoticed. TSA is currently considering changes in airline passenger screening specifically to reduce delays encountered at security checkpoints. For example, the Transportation Security Administration has been exploring a pilot program for registered travelers and the use of biometrics, both of which would allow expedited screening (Biometric Technology Today, 2004; Dean and Kelly, 2005). Indeed, recognition of the need for improved customer service by reducing security-related delays has become an increasingly important issue as the airlines struggle with higher fuel costs and financial instability.

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Still, improvements in airport screening procedures must be placed in the context of evolving passenger tastes and expectations, and the likelihood that they will be satisfied with screening procedures. Understanding the dynamics of passenger satisfaction is critical since the ultimate success of new screening procedures (from a customer service perspective) and the financial viability of the airline industry will be affected.

The objective of this paper is to investigate the factors that significantly affect overall passenger satisfaction with security screening procedures, and to assess how this satisfaction has changed over time—presumably in response to changes in screening procedures and changes in passenger tastes and expectations. Using data from a national household survey, we conduct an empirical investigation by estimating multinomial logit models to assess the temporal stability of passengers' satisfaction with screening procedures.

2. Data

The study data were collected as part of the Omnibus Household Surveys, which were conducted bi-monthly by the Bureau of Transportation Statistics from January 2002 through October 2003. The intent of these surveys was to monitor user expectations of, and satisfaction with various aspects of the transportation system in the post-September 11, 2001 environment. The data for this analysis were assembled from two sets of surveys: a series of three surveys in September, October, and December 2002, and a series of five surveys conducted in February, April, June, August and October of 2003. Using only completed surveys and screening for erroneous data, information for 828 travelers were available for 2002 and for 1079 travelers in 2003. All travelers included in the sample were contacted via telephone.

The summary statistics presented in Table 1 are grouped as individual-specific, household-specific, recent airline flight-specific and other airline travel-specific variables. Within these four categories there is a rich assortment of variables including socio-economic and demographic factors such as gender, age, race, education level, household income and number of adults in the household. Additional data include information on the most recent commercial airline trip including date of travel, trip purpose, self-reported wait time in line at passenger screening, airplane seat location, and ticket restrictions (advanced booking, required overnight stay, or fees required to change tickets).

The primary focus of this paper relates to the evolution of passenger satisfaction over time at security screening points. In comparing values between the 2002 and 2003 surveys, we note there is considerable similarity. However, from 2002 to 2003, passengers report a slight improvement in satisfaction with 78.1% indicating they were satisfied with their experience at passenger screening points in 2003, up from 76.5% in 2002. The percent that were not satisfied with passenger screening declined from 9.8% in 2002 to 7.8% in 2003. While the statistical significance of these possible shifts in satisfaction will be explored later, there does appear to be some increase in satisfaction, possibly resulting from improvements in passenger screening methods and/or changes in passenger tastes/expectations. It is noteworthy that the average self-reported wait time at screening points improved slightly from 2002 to 2003 and the percentage of passengers believing that screening is consistent from one airport to the next increased from 40.5% in 2002 to 71.3% in 2003. This suggests that the TSA procedures have become more uniform over time.

3. Methodological approach

Consideration is given to three possible discrete outcomes when passengers report on satisfaction with their airport security screening experience: unsatisfied, indifferent, and satisfied. Because the survey-response data are ordered (ranging from being less satisfied to more satisfied), one might be led to select an ordered probability model such as the ordered probit or ordered logit model. However, ordered models place a restriction on variable effects which, in our case, would not allow for the possibility of a variable simultaneously decreasing the probability of being unsatisfied and satisfied (alternatively increasing only the probability of being indifferent). Because this is an unnecessary and potentially erroneous restriction, we adopt an unordered discrete outcome model (see Washington et al., 2003, for a further explanation of this point).[1]

The most widely applied discrete-outcome modeling approach is the multinomial logit model. For passenger satisfaction outcomes, this model defines a function that determines satisfaction as

$$W_{in} = \boldsymbol{\beta}_i \mathbf{X}_{in} + \varepsilon_{in}, \tag{1}$$

where W_{in} is the function that determines the probability of discrete satisfaction outcome i for passenger n, $\mathbf{X}_{in}$ is a vector of measurable characteristics (passenger gender, wait time, age, etc.) that determine the satisfaction for passenger n, $\boldsymbol{\beta}_i$ is a vector of estimable coefficients, and ε_{in} is an error term accounting for unobserved effects influencing the satisfaction of passenger n.

It can be shown that if ε_{in} are assumed to be extreme value distributed (see McFadden, 1981), then a standard multinomial logit model results

$$P_n(i) = \frac{\mathrm{EXP}[\boldsymbol{\beta}_i \mathbf{X}_{in}]}{\sum_{\forall I} \mathrm{EXP}[\boldsymbol{\beta}_\mathrm{I} \mathbf{X}_\mathrm{In}]}, \tag{2}$$

[1]To check this, we estimated ordered probit models on our data and found the statistical fit to be inferior to our chosen unordered modeling approach—the multinomial logit model.

Table 1
Summary statistics for passenger and recent commercial airline flight variables

	2002	2003
Individual-specific variables		
Male/female respondents (%)	46.9/53.1	45.8/54.2
Respondents between 18 and 24 years (%)	7.7	7.0
Respondents between 25 and 34 years (%)	17.5	18.1
Respondents between 35 and 44 years (%)	24.4	22.3
Respondents between 45 and 54 years (%)	24.4	24.7
Respondents between 55 and 64 years (%)	15.5	15.4
Respondents between 65 and 74 years (%)	8.2	7.8
Respondents 75 years or older (%)	2.3	4.7
Hispanic respondents (%)	3.6	6.3
Black or African-American respondents (%)	3.3	3.9
Asian respondents (%)	7.2	8.2
White respondents (%)	87.5	84.4
Respondents with a high-school degree or less (%)	18.0	19.3
Respondents with a college degree (%)	56.5	57.7
Respondents with a graduate-school degree (%)	25.5	23.0
Respondents with a 4-year college or graduate-school degree (%)	56.2	53.5
Household-specific variables		
Average number of adults in household	1.95	1.99
Respondents with a household annual income < \$30,000 (%)	14.0	13.6
Respondents with a household annual income \$30,000 to \$75,000 (%)	43.5	44.8
Respondents with a household annual income > \$75,000 (%)	42.5	41.6
Recent airline flight-specific variables		
Respondents who traveled on a commercial airline <3 mo prior to survey (%)	55.5	50.9
Business-related airline trips (%)	22.8	25.0
Male/female respondents traveling in economy or coach class (%)	38.7/42.5	35.3/43.5
Respondents traveling in first class (%)	4.9	6.3
Respondents with airline ticket restrictions (%)	67.3	61.5
Average self-reported wait time in passenger screening line (minutes)	16.1	15.4
Average self-reported wait time in line—male/female (minutes)	16.6/15.7	15.3/15.5
Percentage frequency of satisfaction rankings about respondent's experience at passenger screening points (unsatisfied/indifferent/satisfied)	9.8/13.7/76.5	7.8/14.1/78.1
Percentage of passengers thinking the time spent waiting in line at passenger screening was less than/equal to/greater than expected	45.4/47.6/7.0	36.6/53.7/9.7
Other Airline Travel-Specific Variables		
Percentage of passengers believing passenger screening is consistent from one airport to the next	40.5	71.3
Respondents less inclined to travel after post-September 11, 2001 passenger screening changes (%)	19.9	15.5

where $P_n(i)$ is the probability that passenger n will have satisfaction outcome i and I is the set of possible satisfaction outcomes.

To assess the vector of estimated coefficients ($\boldsymbol{\beta}_i$), we calculate elasticities which measure the magnitude of the impact of specific variables on the outcome probabilities. The elasticity is computed for each passenger n (n subscripting omitted) as

$$E_{x_{ki}}^{P(i)} = \frac{\partial P(i)}{\partial x_{ki}} \times \frac{x_{ki}}{P(i)}, \tag{3}$$

where $P(i)$ is the probability of satisfaction outcome i and x_{ki} is the value of variable k for outcome i. Using Eqs. (2) and (3) gives

$$E_{x_{ki}}^{P(i)} = [1 - P(i)]\beta_{ki}x_{ki}. \tag{4}$$

where β_{ki} is the estimated coefficient associated with variable x_{ki}. Elasticity values can be roughly interpreted as the percent effect that a 1% change in x_{ki} has on the satisfaction-outcome probability $P(i)$.

Note that elasticities are not applicable to indicator variables (those variables taking on values of 0 or 1).[2] In these cases, a pseudo-elasticity can be calculated as

$$E_{x_{ki}}^{P(i)} = \left[\frac{\text{EXP}(\beta_{kI})\sum_{i=1}^{I}\text{EXP}(\boldsymbol{\beta}_i\mathbf{X}_i)}{\sum_{i=1}^{I}\text{EXP}[\Delta(\boldsymbol{\beta}_i\mathbf{X}_i)]} - 1\right] \times 100, \tag{5}$$

where I is the set of all possible satisfaction outcomes, $\Delta(\boldsymbol{\beta}_i\mathbf{X}_i)$ is the value of the function (see Eq. (1)) determining the satisfaction level after x_{ki} has been changed from zero to one, and $\boldsymbol{\beta}_i\mathbf{X}_i$ is the value when $x_{ki} = 0$. The pseudo-elasticity of a variable with respect to a satisfaction outcome category represents the percent change in the probability of that severity category when the variable is changed from zero to one. Thus, a pseudo-elasticity of 42.0 for a variable in the unsatisfied category means that the probabilities of the unsatisfied outcome for these passengers increased by 42% (this is an average since we will report the average value over all passenger).[3]

4. Estimation results

To assess possible shifts in passenger satisfaction in airports security over time, separate 2002 and 2003 multinomial logit models were estimated with the data. The estimation results for the multinomial logit model using the 2002 data are presented in Table 2, with corresponding elasticities in Table 3.

[2]Due to the nature of the data (with a preponderance of indicator variables), many of the statistically significant explanatory variables were indicator variables. This does not present a problem for estimation or interpretation of findings. Also, when statistically justified, we interact indicator variables with continuous variables (such as the wait time in line for women).

[3]See Washington et al. (2003) for a complete explanation of elasticities.

Table 2
Multinomial logit model for passenger-perceived satisfaction ratings at passenger screening points using 2002 data. Variables are defined for outcomes: [U] unsatisfied, [I] indifferent, [S] satisfied

	Estimated coefficient[a]
Independent variable	
Constant [U]	−4.32**
Constant [I]	−2.71**
Individual-specific variables	
Male (1 if passenger is male) [S]	0.48*
Age category 2 (1 if passenger is between 25 and 34 years old) [S]	−0.46*
Age category 4 (1 if passenger is between 45 and 54 years old) [S]	−0.70*
Age category 5 (1 if passenger is between 55 and 64 years old) [U]	0.59*
Age category 7 (1 if passenger is 75 years old or older) [U]	1.28
Level of Education 1 (1 if passenger is at most a high-school graduate) [I]	−0.42
Household-specific variable	
Income category 3 (1 if household's total annual income is over $75,000) [S]	−0.52**
Recent airline flight-specific variables	
Primary purpose of the trip (1 if most recent trip was business-related) [S]	0.38*
Wait time (hours) in line if passenger is male [U][b]	3.74**
Wait time (hours) in line if passenger is female [U][b]	1.66**
Predicted probability that the amount of time spent waiting was more than the passenger expected [S][c]	−10.70*
Restricted airline ticket (1 if yes, 0 otherwise) [S]	−0.36*
Section of seat location (1 if seat was located in economy or coach section) [I]	−0.45*
Other airline travel-specific variables	
Inclination to travel after September 11, 2001 (1 if passenger is less inclined to travel) [S]	−0.59**
Number of observations	828
Initial log-likelihood	−909.7
Log- likelihood at convergence	−546.3

[a]Two-tailed *t*-test results: **significantly different from zero at more than 99% confidence, *significantly different from zero at more than 95% confidence.
[b]Wait time generated from an estimated regression model (see text).
[c]Predicted probabilities generated from an estimated binary logit model (see text).

Table 3
Estimated elasticity values of the multinomial logit model using 2002 data[a]

Variable[b]	Elasticity
Individual-specific variables	
Male (1 if passenger is male) [S]	5.1
Age category 2 (1 if passenger is between 25 and 34 years old) [S]	−2.2
Age category 4 (1 if passenger is between 45 and 54 years old) [S]	−5.4
Age category 5 (1 if passenger is between 55 and 64 years old) [U]	8.1
Age category 7 (1 if passenger is 75 years old or older) [U]	2.6
Level of Education 1 (1 if passenger is at most a high-school graduate) [I]	−6.9
Household-specific variable	
Income category 3 (1 if household's total annual income is over $75,000) [S]	−7.0
Recent airline flight-specific variables	
Primary purpose of the trip (1 if most recent trip was business-related) [S]	1.7
Wait time (hours) in line if passenger is male [U][c]	0.43
Wait time (hours) in line if passenger is female [U][c]	0.20
Predicted probability that the amount of time spent waiting was more than the passenger expected [S][d]	−0.19
Restricted airline ticket (1 if yes, 0 otherwise) [S]	−6.3
Section of seat location (1 if seat was located in economy or coach section) [I]	−31.7
Other airline travel-specific variables	
Inclination to travel after September 11, 2001 (1 if passenger is less inclined to travel) [S]	−3.8

[a]Reported elasticities are averages over the passenger sample. Elasticities for indicator variables (0,1) represent the change in the probability following a change in the variable from zero to one.
[b][U] unsatisfied, [I] indifferent, [S] satisfied.
[c]Wait time generated from an estimated regression model (see text).
[d]Predicted probabilities generated from an estimated binary logit model (see text).

For individual- and household-specific variables, our results show that passengers in age groups 25–34 and 45–54 years old were less likely to be satisfied; that respondents with at most a high school level education were less likely to be indifferent; and that individuals with household incomes exceeding $75,000 per year were less likely to be satisfied. It is difficult to speculate on the reasons for these findings; it is possible that different expectations of these individuals, or the manner in which they were treated in the passenger screening process may be coming into play. These results do support previous studies of airline passenger satisfaction, which suggest that service expectations vary among potentially different consumer groups (Aksoy et al., 2003; Sultan and Simpson, 2000). However, Table 3 indicates that these variables are not highly influential in terms of their impact on satisfaction probabilities. For example, being 45–54 years old decreases the probability of being satisfied by 5.4%. Although statistically significant, Table 3 shows that all of the individual- and household-specific variables (which are all indicator variables) have less than a 10% impact on the probabilities.

For airline flight and airline travel variables, we find that travelers on a business related trip were statistically more likely to be satisfied, but that the magnitude was not great—with business trip purpose increasing the probability of being satisfied by less than 2% (Table 3). Although the magnitude of the impact is small, the general finding is consistent with those of Gilbert and

Wong (2003) in which significant differences in service expectations were found among passengers traveling for different purposes.

As expected, the longer that passengers had to wait to be screened, the longer they were to be unsatisfied.[4] Interestingly, our estimation shows that men are more sensitive to wait time than women—with increasing waiting time having a larger impact on the likelihood of men being unsatisfied.[5] Table 3 shows, on average, a 1% increase in the wait time increases the probability that a man will be satisfied by 0.43% as opposed to a 0.20% increase in the probability that a woman will be unsatisfied.

As was the case with self-reported wait times, passengers indicating that the amount of time spent waiting was greater than expected is likely to be endogenous, with satisfied passengers more likely to indicate that the wait time was not more than expected and unsatisfied customers more likely to indicate that the wait time was more than expected. To resolve this estimation problem, we estimated binary logit models to predict the probability of indicating wait times were longer than expected using all exogenous variables. The predicted probabilities are then used in the multinomial logit satisfaction model. Tables 2 and 3 show that the probability of thinking wait time was more than expected decreased the probability of being satisfied—with a 1% increase in the probability of thinking wait time was more than expected decreasing the probability of being satisfied by 0.19%.

The tables also show that passengers having restricted tickets (having penalties for exchanges, etc.) were on average a little more than 6% less likely to be satisfied, and those in economy or coach section were almost 32% more likely to be indifferent. Other findings show that passengers indicating they were less inclined to travel after September 11, 2001 were almost 4% less likely to respond that they were satisfied.

The estimation results for the model using 2003 data are presented in Table 4 with corresponding elasticities in Table 5. The results show many differences between this model and the one estimated on 2002 data. For example, in 2003, the male indicator variable is now significant with men being less likely to be satisfied (this variable was statistically insignificant when using 2002 data to estimate the model). Also, in 2003, the effect of age changes—with age groups 55–64 and 75 and older now being significantly more likely to be satisfied. In 2003, the coefficient estimated for high-income travelers switches signs with high income households now more likely to be satisfied than their lower income counterparts instead of less likely to be satisfied as they were in 2002.

Unlike the 2002 data, racial group effects were found to be significant in 2003. White passengers were about 11% less likely to be satisfied, on average, and Hispanic passengers were 2% more likely to be indifferent. The education effect also changed from 2002, with individuals with a 4-year college or graduate degree being less likely to be unsatisfied (about 23% less likely on average) as

Table 4
Multinomial logit model for passenger-perceived satisfaction ratings at passenger screening points using 2003 data. Variables are defined for outcomes: [U] unsatisfied, [I] indifferent, [S] satisfied

	Estimated coefficient[a]
Independent variable	
Constant [U]	−0.14
Constant [I]	1.08
Individual-specific variables	
Male (1 if passenger is male) [S]	−0.39
Age category 5 (1 if passenger is between 55 and 64 years old) [S]	0.64**
Age category 7 (1 if passenger is 75 years old or older) [S]	1.17
Racial Group 1 (1 if passenger is Hispanic) [I]	0.74*
Racial Group 4 (1 if passenger is White) [S]	−0.60**
Level of Education 4 (1 if passenger has a 4-year college or graduate-school degree) [U]	−0.45*
Household-specific variable	
Income category 3 (1 if household's total annual income is over $75,000) [S]	0.59**
Recent airline flight-specific variables	
Wait time (hours) in line if passenger is male [U][b]	2.73*
Wait time (hours) in line if passenger is female [U][b]	1.48**
Predicted probability that the amount of time spent waiting was more than the passenger expected [S][c]	−10.71*
Restricted airline ticket (1 if yes) [S]	−0.21
Section of seat location if passenger is male (1 if seat was located in economy or coach section) [S]	0.56*
Other airline travel-specific variables	
Predicted probability about the perceived consistency of screening procedures in airports from which the passenger has departed [S][c]	5.98**
Inclination to travel after September 11, 2001 (1 if passenger is less inclined to travel) [U]	1.38**
Inclination to travel after September 11, 2001 (1 if passenger is less inclined to travel) [I]	0.68**
Number of observations	1079
Initial log-likelihood	−1205.2
Log- likelihood at convergence	−680.3

[a]Two-tailed *t*-test results: ** significantly different from zero at more than 99% confidence, * significantly from zero at more than 95% confidence.

[b]Wait time generated from an estimated regression model (see text).

[c]Predicted probabilities generated from an estimated binary logit model (see text).

[4]The wait times that we have are self-reported. Thus there exists the possibility that unsatisfied passengers may be more likely to over-report wait times and satisfied customers may be more likely to under-report wait times. If this is the case, the wait time variable would be endogenous and the resulting model-estimated coefficients would be inconsistent. To resolve this problem, we use an instrumental variables approach by regressing self-reported wait times on all exogenous variables and using the regression-predicted values as the independent variable in the multinomial logit estimations.

[5]Using a likelihood ratio test, male and female wait-time coefficients were found to be significantly different at the 95% confidence level.

Table 5
Estimated elasticity values of the multinomial logit model using 2003 data[a]

Variable[b]	Elasticity
Individual-specific variables	
Male (1 if passenger is male) [S]	−3.9
Age category 5 (1 if passenger is between 55 and 64 years old) [S]	1.5
Age category 7 (1 if passenger is 75 years old or older) [S]	0.2
Racial Group 1 (1 if passenger is Hispanic) [I]	2.0
Racial Group 4 (1 if passenger is White) [S]	−11.4
Level of Education 4 (1 if passenger has a 4-year college or graduate-school degree) [U]	−23.4
Household-specific variable	
Income category 3 (1 if household's total annual income is over $75,000, 0 otherwise) [S]	5.1
Recent airline flight-specific variables	
Wait time (hours) in line if passenger is male [U][c]	0.30
Wait time (hours) in line if passenger is female [U][c]	0.19
Predicted probability that the amount of time spent waiting was more than the passenger expected [S][c]	−0.23
Restricted airline ticket (1 if yes) [S]	−3.0
Section of seat location if passenger is male (1 if seat was located in economy or coach section) [S]	4.0
Other airline travel-specific variables	
Predicted probability about the perceived consistency of screening procedures in airports from which the passenger has departed [S][d]	0.91
Inclination to travel after September 11, 2001 (1 if passenger is less inclined to travel) [U]	17.9
Inclination to travel after September 11, 2001 (1 if passenger is less inclined to travel) [I]	8.4

[a]Reported elasticities are averages over the passenger sample. Elasticities for indicator variables (0,1) represent the change in the probability following a change in the variable from zero to one.

[b][U] unsatisfied, [I] indifferent, [S] satisfied.

[c]Wait time generated from an estimated regression model (see text).

[d]Predicted probabilities generated from an estimated binary logit model (see text).

opposed to the 2002 finding where the only significant educational effect was that passengers with at most a high-school education were less likely to be indifferent. These findings suggest some noticeable shifts in passenger tastes/expectations between 2002 and 2003.

For airline flight and travel variables, the 2003 data show that business travel is no longer a significant factor in determining passenger satisfaction, but that increasing wait time again significantly decreases the likelihood of being satisfied (and that men are again more sensitive to this than women). However, the elasticities suggest that both men and women were less sensitive to wait times in 2003 (relative to 2002). A one percent increase in wait time now results in 0.3% reduction in the probability of being satisfied (down from a 0.43% reduction in 2002) for men, and a 0.19% reduction in the probability of being satisfied for women (down slightly from a 0.20% reduction in 2002).

As was the case in 2002, we again find that having a restricted ticket results in a slight decrease in the probability of being satisfied. However, we do find differences in the effect of economy and coach seats. Recall that in 2002 we found that all passengers in economy and coach were more likely to be indifferent. In 2003, we find that economy and coach tickets now increase the probability of being satisfied, but only for male passengers.

In 2003, the amount of time waiting being more than expected was again statistically significant with a 1% increase in the probability of the wait time being more than expected resulting in a 0.23% increase in the probability of being satisfied (up from 0.19% in 2002). Unlike 2002, the probability of perceived consistency of screening procedures in airports was found to be significant in 2003, and it increased the probability of being satisfied (with a 1% increase in this probability increasing the probability of being satisfied by 0.91%).[6]

Finally, in 2002 we found that passengers less inclined to travel after September 11, 2001 were less likely to be satisfied. We find a similar but somewhat different result in 2003 with these passengers being more likely to be unsatisfied (17.9% elasticity) and more likely to be indifferent (8.4% elasticity).[7]

While the analysis of individual coefficient estimate differences in the 2002 and 2003 models are suggestive, we conducted a likelihood ratio test to determine whether the hypothesis that the two estimated models are the same can be rejected. To test if the 2002 and 2003 models are statistically different, we estimated a model on all data (both years) and then compared to the separately estimated 2002 and 2003 models. The test statistic is

$$X^2 = -2[LL(\boldsymbol{\beta}_{\text{all}}) - LL(\boldsymbol{\beta}_{2002}) - LL(\boldsymbol{\beta}_{2003})], \qquad (6)$$

where $LL(\boldsymbol{\beta}_{2002})$ is the model's log-likelihood at convergence of the model estimated on all data, $LL(\boldsymbol{\beta}_{2002})$ is the log-likelihood at convergence of the model estimated on 2002 data, and $LL(\boldsymbol{\beta}_{2003})$ is the log-likelihood at convergence of the model estimated on 2003 data. This statistic is χ^2 distributed with degrees of freedom equal to the summation of coefficients estimated in the 2002 and 2003 models minus the number of coefficients estimated in the total-data model. The χ^2 value of this test was 117.63 with 17 degrees of freedom. The critical χ^2 value at the 99.99%

[6]As was the case with the amount of time waiting being more than expected, we speculate that perceived consistency may be endogenous in that passengers that are satisfied may be more likely to report that screening procedures are consistent among airports. To resolve this problem and arrive at consistent estimates in the multinomial logit model, we again estimate a binary logit model of the probability of stating that airport screening procedures are consistent using exogenous variables. We then use these estimated probabilities to estimate the passenger satisfaction model.

[7]The 2002 result implies that the effect of the "inclination" variable on the unsatisfied and indifferent outcomes is also positive, but the same magnitude. A likelihood ratio test indicates that the effect on unsatisfied and indifferent in 2003 is now significantly different with over 95% confidence. See Washington et al. (2003) for further explanation of coefficient interpretations and the likelihood ratio test.

confidence level is 39.13. Therefore we can reject, with a high level of confidence, the hypothesis that the factors determining passenger satisfaction did not change from 2002 to 2003.

5. Conclusions

Bowen and Headley (2000) have argued that, in general, customer service, reliability and safety are among the most important variables affecting airline passenger expectations. There is little question that the effectiveness and efficiency of security screening is a key feature affecting passenger satisfaction. Our results suggest that, overall, the TSA has been effective in federalizing airport security from a passenger satisfaction perspective, because we do not observe any systematic differences in passenger satisfaction from one airport to the next after all observable variables are controlled (airport-specific indicator variables were not found to be significant in any of the models).[8]

The current course of the TSA appears to be one that focuses on reducing wait times in an effort to improve customer satisfaction—as indicated in February 2004 hearing before the Subcommittee on Aviation in which the Administration plainly stated that its goal was to reduce passenger screening time. Thus far, strategies for accomplishing this reduction in screening time have centered on the use of a registered passenger system, passenger risk grouping (allowing the number of security checks to vary by group) and workforce additions (Babu et al., 2006; Gilbert and Wong, 2003). However, our results raise an important, cautionary flag with regard to these proposed security improvements. For example, while wait time was found to significantly increase the probability of a passenger being unsatisfied—in both 2002 and 2003 wait times were inelastic (a 1% change in wait time had a less than a 1% change in the probability of being unsatisfied). Our results clearly show that factors other than wait time significantly affect customer satisfaction with screening procedures. Perhaps more important is our finding that the determinants of passenger satisfaction with airport screening are not stable over time. This instability has important consequences for future policies related to improvements in airport screening procedures. The temporal instability of passenger satisfaction underscores the need for careful market research and additional data and analysis before any improvements are considered to ensure that planned improvements have maximum effectiveness on overall passenger satisfaction. As an example, the recently proposed Secure Flight program (a centralized program proposed for comparing passenger names against known terrorist threats) could have negative impacts on passenger satisfaction depending on how the program is ultimately designed (US Government Accountability Office, 2005). Because the Omnibus Surveys are no longer conducted, alternative channels need to be identified to provide information on commercial airline travel patterns, and to monitor airline passengers' expectations of and satisfaction with airport screening procedures.

[8]As some supporting evidence for this finding, we were able to explore the consistency of wait times across airports using hourly data that have been collected including the average and maximum wait times for each one-hour period. Using wait-time data collected in 2004–2005 at the nation's 10 busiest airports (defined by number of passengers), we found reasonable consistency across airports in terms of the average mean and average maximum wait times and their standard deviations over hourly periods for which the data were collected. To test for statistically significant differences in wait times among these airports, a negative binomial regression was estimated on these data (the data are provided as non-negative integers, in one-minute intervals). The estimation findings show that, when controlling for time of day and day of week, there were indeed statistically significant wait-time differences among the nation's 10 busiest airports. However, the magnitude of the differences tended to be quite small—with airport-specific differences in average wait times typically less than two minutes. Thus, airport-specific effects seem to play a relatively small role in both wait-times and overall customer satisfaction.

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