# Houston Airport System Economic Impact Study

## Final Report
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# 1. Introduction

GRA, Incorporated conducted an economic impact analysis of the Houston Airport System (HAS) and each of its airports, evaluating total employment, earnings, and output for the many businesses and entities that operate at or rely on the airport system. Economic impact studies focus on the act of producing transportation and related services as well as the spending by visitors to the region. Section II describes the results of the study. Section III presents the methodology used to measure economic impacts. The appendix contains supporting data. Attachments A, B and C detail the results for Houston George Bush Intercontinental Airport, Houston William P. Hobby Airport, and Ellington Airport, respectively.

As part of the government of the City of Houston, Texas, the Houston Airport System (HAS) is responsible for the operation and management of the two commercial airports and one general aviation airport serving the Houston metropolitan area. Combined, the three airports form one of North America's largest public airport systems. The following sections describe the Houston Airport System and the market that is served by the three airports within the Houston Airport System.

Houston is a national and regional center of commerce that generates vigorous travel demand from both visitors and residents. Its airports move people and goods within the region, across the nation and throughout the world. Houston is the United States' fourth largest city, with a population of over 2.25 million[1], and is the center of the nation's fifth largest metropolitan area—the Houston-Sugarland-Baytown metropolitan statistical area (MSA)—with an estimated population of 6.1 million.

Houston's regional economy is historically based in the energy and petrochemical industries. In recent decades, it has experienced growth in the high technology, medical research, health care, and professional services industries. Today, oil and gas exploration, basic petroleum refining, petrochemical production, medical research and health care delivery, and high-technology (computer, environmental, aerospace, etc.) are the Houston region's five largest industries.[2] Houston is an international hub for the energy and petrochemicals industries with linkages throughout the world. Houston serves as the headquarters for 25 Fortune 500 companies.[3]

Overall, the vast majority of long distance visitors to the Houston region choose to travel by air. These travel needs are met by the Houston Airport System, which consists of two large airports providing commercial passenger and cargo services—George Bush Intercontinental Airport and Houston Hobby Airport. In total, these two airports serve about 49 million annual commercial passengers including arriving, departing and connecting passengers. A joint civil-military reliever airport, Ellington Airport is located in the Southeast portion of the city and serves DOD, NASA and private aviation needs.

[1] 2010 Census
[2] visithousontexas.com
[3] Fortune 500, April 2010

George Bush Intercontinental Airport (IAH) serves as the primary domestic and international commercial service airport for the region. During the fiscal 2010 year, IAH served over 500,000 commercial aircraft operations and over 40 million annual passengers.[4] IAH was a major hub for Continental Airlines, and will play a major role in the merged United-Continental network. It is the network connecting point for Central and South America. IAH also has a number of business jets based at the airport.

Houston Hobby Airport (HOU) serves domestic air travel needs for the Houston region. HOU is known for having frequent service and low fares, and is a focus airport for Southwest Airlines. Hobby Airport handled approximately nine million passengers during the 2010 fiscal year, with almost 140,000 commercial aircraft operations. Because of its proximity to downtown, Hobby is also an important general aviation (GA) airport serving the business travel needs of the many companies in the region. Most of this activity is with high-performance turbine engine aircraft that operate throughout the U.S. and overseas, and most of the turbine GA aircraft based in the Houston region are located at Hobby.

As a reliever airport, Ellington Airport (EFD) primarily serves general aviation and military aircraft operations, and is the base for NASA flight operations at the Johnson Space Center. U.S. government flight units and military reserve units as well as the Texas Air National Guard have large operations at EFD.

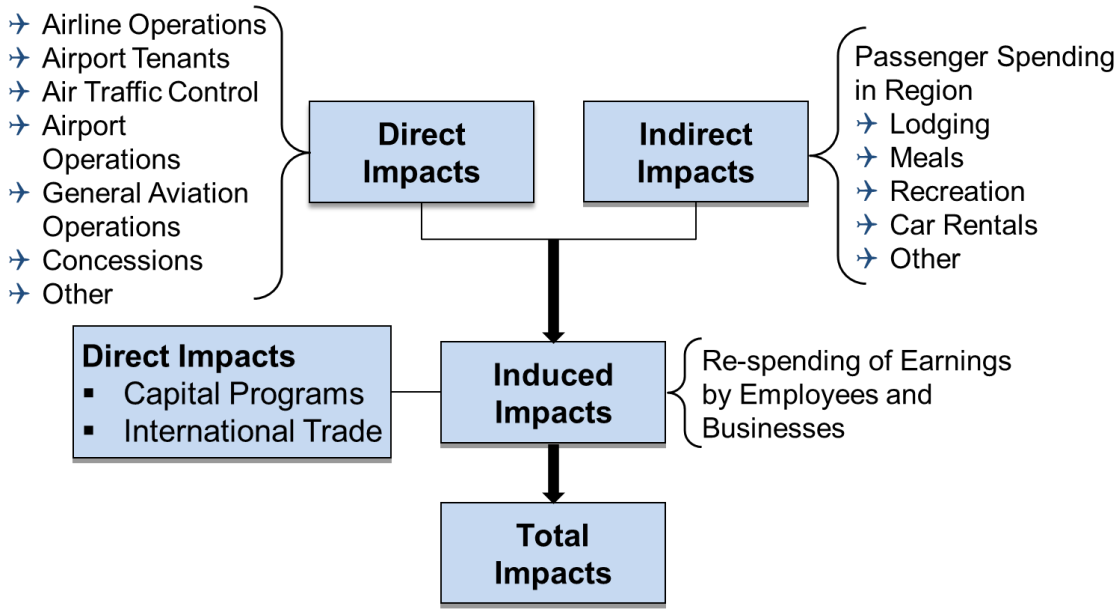
The sections that follow report on the measurement of economic impacts of these three airports, and then provide detailed estimates of impacts for each of the three airports and for HAS overall. These impacts come from the production of aviation and related services at the three airports and from the spending of airport-dependent entities in the Houston region. These are treated as "direct" impacts. Air travelers also spend considerable sums in the local economy; these expenditures are treated as "indirect" impacts. These impacts include the spending by residents for transportation to and from the airport, for airport parking and spending on airport concessions. This study also captures spending on concessions by connecting passengers. Finally, visitors to the region spend considerable sums on lodging, meals and transportation along with other expenses, which are also included among the "indirect" impacts.

In addition, the HAS Economic Impact Study incorporates the impacts of capital programs and international trade. The data and methods used to estimate these are discussed below.

As shown in Figure 1, the earnings associated with direct impacts and the spending represented by the indirect impacts are spent in the region and these are then re-spent by the recipients of this spending. A U.S. government model of the Houston regional economy is used to measure these "induced" impacts (often referred to as "multiplier effects"), and how much additional income and employment remains in the local economy after all rounds of spending. Some of the impact "leaks out" of the local economy for goods and services not produced in the Houston Region. The study reports three measures of economic impacts including employment, earnings and output, and the total impact includes direct, indirect and induced impacts.

[4] FAA TAF

**Figure 1: Economic Impact Overview**



# 2. Summary of Results

## 2.1 Summary of Economic Impacts

The total economic impact in 2010 of the Houston Airport System was over $27.5 billion for the Houston regional economy. It is the combined economic impact of Houston George Bush Intercontinental Airport, Houston William P. Hobby Airport, and Ellington Airport. This total was comprised of direct ($8.7 billion), indirect ($3.7 billion) and induced ($15.2 billion) impacts of the airports and their related entities.[5] Direct impacts are those used in the production of passenger, cargo, government and private air transportation services and include the impacts of average annual capital expenditures, while indirect impacts come from spending in the local economy by air visitors. Induced impacts come from the spending and re-spending by recipients of income due to the direct and indirect impacts.

As shown in Table 1, the three Houston Airport System airports are responsible for over 234,000 full time equivalent jobs, generating $8.8 billion in employee and proprietor earnings. Direct, indirect and induced employment impacts exceed 47,000, 47,500 and 139,000 full time equivalent jobs, respectively. Houston Airport System employment generates earnings of over $3.1 billion for direct employment, $1.1 billion for indirect employment and $4.5 billion for induced employment. Of these impacts, $27.1 billion represents the impacts from the production and use of air transportation and selected services and visitor spending, while $434 million represents the annual average impact of capital spending on airport infrastructure.

**Table 1: Total Economic Impact of Houston Airport System Airports**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Direct | 47,456 | $3,132.7 | $8,666.7 |
| Indirect | 47,713 | $1,125.0 | $3,663.6 |
| Induced | 139,113 | $4,593.2 | $15,227.4 |
| **Total** | **234,281** | **$8,850.9** | **$27,557.8** |

Figure 2 shows the shares of direct, indirect and induced output. The direct and indirect impacts account for about 45 percent of the total and induced impacts account for the other 55 percent.

[5] The current estimates include the average annual impacts of the HAS Capital Improvement Plan.

**Figure 2: Total Economic Impact of Output, by Type**

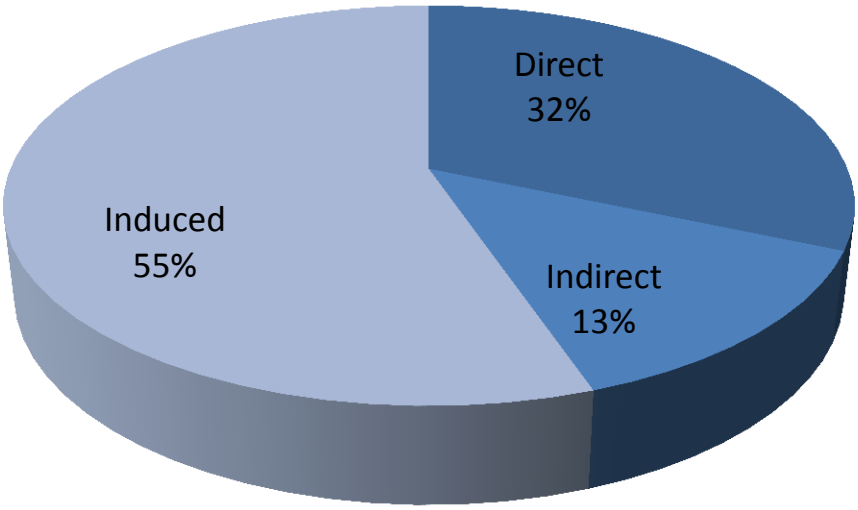


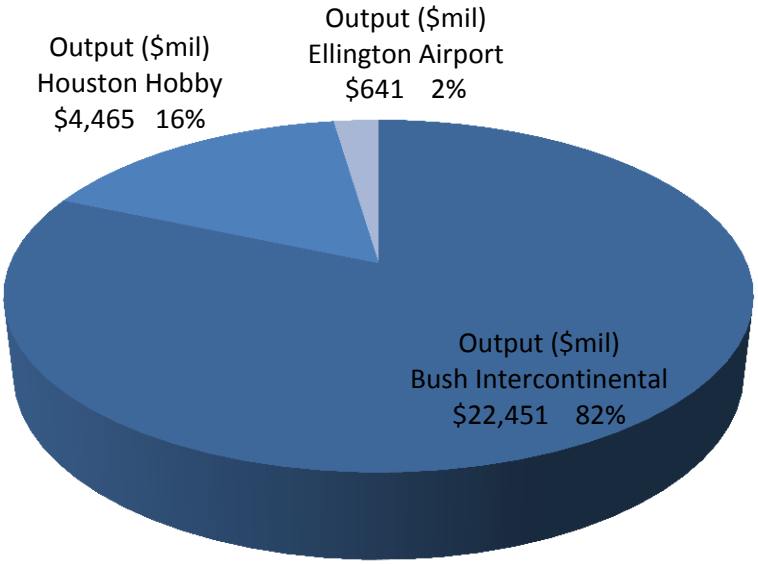

Table 2 reports the economic impacts for each of the three HAS airports. The total economic impact of George Bush Intercontinental Airport (IAH) was over $22 billion. IAH activity results in over 172,000 full time equivalent employees, with total earnings impact exceeding $6.8 billion. Houston Hobby is responsible for over 52,000 full time equivalent jobs, with total earnings impact of $1.7 billion. The economic impact of Houston Hobby Airport was over $4.4 billion in economic output. Ellington Airport supports over 10,000 jobs in the regional economy with the total earnings impact of over $307 million. The output impact of Ellington Airport is over $640 million.

**Table 2: Total Impacts by Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Bush Intercontinental | 172,108 | $6,833.4 | $22,451.4 |
| Houston Hobby | 52,069 | $1,709.8 | $4,465.3 |
| Ellington Airport | 10,104 | $307.7 | $641.1 |
| **Total** | **234,281** | **$8,850.9** | **$27,557.8** |

Figure 3 shows that IAH accounts for 82 percent of the HAS impact. HOU accounts for 16 percent and EFD about two percent. In a companion study, the University of Houston examined the links between international air travel and trade. These impacts are not included in the above estimates, but are discussed below in Section 3.7

**Figure 3: Total Economic Impact of Output, by Airport**




## 2.2 Direct Impacts

Table 3 shows that the direct output impacts exceed $8.6 billion for the three Houston Airport System airports. The direct employment impact exceeds 47,000 jobs and direct earnings from these jobs exceed $3 billion. An overwhelming majority of the output, earnings and employment can be attributed to airlines, which generate over $5.6 billion and $2.1 billion in output and earnings respectively, and employ over 24,000 people. This study includes all employees within the Houston region for Continental and Southwest Airlines, including based flight and cabin crews as well as maintenance, administrative and other personnel, whether located at an airport or not. Cargo service providers provided the next highest output level, followed by government airport-related activities, which produce $984 million and $662 million in output, respectively.

**Table 3: Direct Economic Impact of HAS Airports**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Airlines | 24,498 | $2,106.8 | $5,600.1 |
| Airport Passenger Services | 1,299 | $33.4 | $131.4 |
| Passenger Ground Transportation | 7,193 | $373.5 | $579.4 |
| Airport and Aircraft Services | 1,809 | $93.8 | $231.2 |
| Cargo Services | 2,528 | $110.8 | $984.1 |
| Non-Airlines Aircraft Operations | 288 | $16.2 | $110.9 |
| Government | 4,004 | $211.4 | $662.2 |
| Department of Defense | 4,028 | $109.1 | $172.7 |
| Average Annual CIP | 1,809 | $77.6 | $194.8 |
| **Total** | **47,456** | **$3,132.7** | **$8,666.7** |

Figure 4 shows the distribution of direct impacts by sector. Airlines account for almost two-thirds of the impact; cargo services, government and ground transport are the next largest entities in terms of output.

**Figure 4: Direct Impacts by Sector**

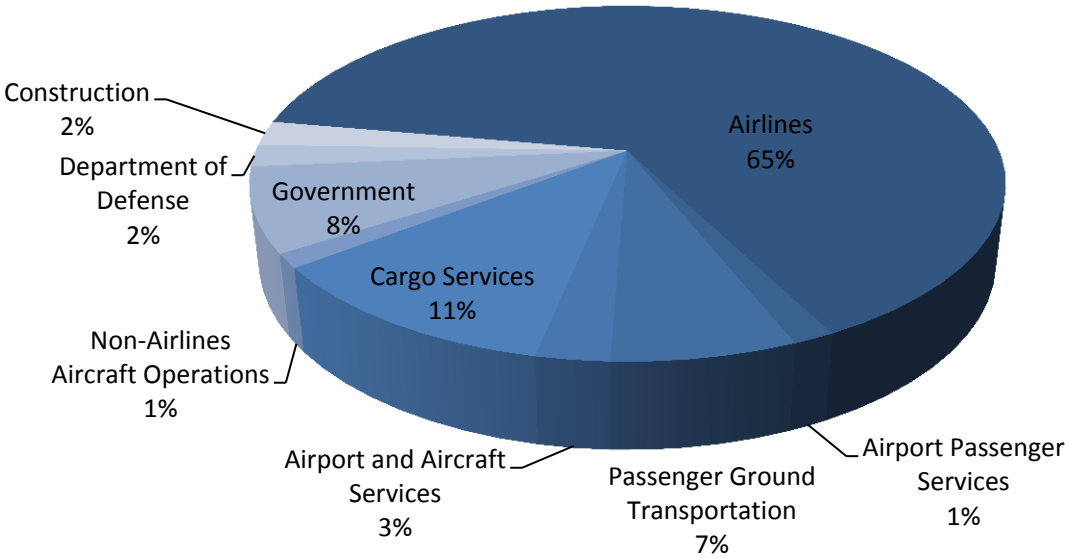


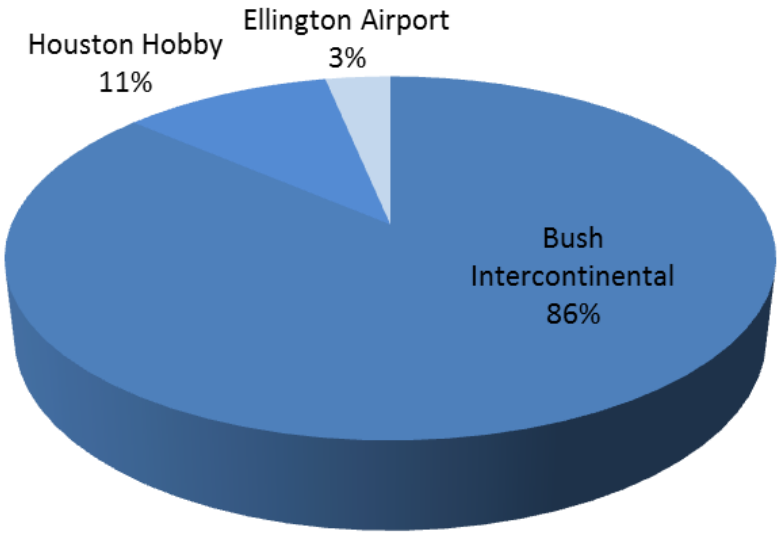

Table 4 shows that Bush Intercontinental generated over $7.4 billion in direct output impacts, including over $2.5 billion in earnings and over 35,000 jobs. Houston Hobby generated over 7,000 jobs, over $465 million in earnings, and over $900 million in output. In terms of output, Ellington Airport‘s economic impact is over $280 million, generating over 4,700 jobs and over $143 million in earnings.

**Table 4: Direct Impacts by Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Bush Intercontinental | 35,557 | $2,521.9 | $7,479.9 |
| Houston Hobby | 7,172 | $466.9 | $906.1 |
| Ellington Airport | 4,726 | $143.9 | $280.7 |
| **Total** | **47,456** | **$3,132.7** | **$8,666.7** |

Figure 5 shows the distribution of impacts by airport. In terms of direct output IAH accounts for 86 percent of the total direct impact, while HOU and EFD account for the remaining 14 percent.

**Figure 5: Direct Output Impacts by Airport**



# 3. Economic Impact Methodology and Results

## 3.1 Introduction

Airports have a significant role in a regional economy supporting business activities that rely on travel and cargo availability and quality, while acting as centers of business in their own right. The airports of the Houston Airport System are no exception, supporting domestic and international travel for local residents and visitors to the region, and facilitating the trade of time sensitive goods via air cargo. Commercial aviation provides an important productivity tool for businesses in the form of high speed, direct air transportation. Like any large undertaking, HAS also generates valuable economic impacts through a "ripple effect" affecting the regional economy via the spending of those that produce air transportation and its supporting activities, airport construction and development, and the expenditures of air visitors. These economic impacts can be separated into direct, indirect, and induced economic impacts, which are described below.

*Direct Impacts* are those generated by transportation and other direct uses of the airports. These impacts are measured with the employment, earnings, and the output associated with the following industries and entities:

- Commercial airlines and scheduled air charter operations (both passenger and cargo)
- Airport concessionaires, which provide air passengers with goods and services
- Passenger ground transportation providers (including parking)[6]
- Airport and aircraft service providers
- Air cargo service providers
- General aviation (non-commercial) aircraft operators (i.e. flight schools)
- Government agencies supporting airport use
- Airport dependent Department of Defense and National Guard activities

Direct impacts also include expenditures that are made on airport capital investments, which are measured by the budget allocated for the project. These activities are converted into average annual impacts so they can be meaningfully added to the other direct impacts, which are associated with a specific year.

*Indirect Impacts* are derived by estimating the expenditures of air travelers who visit the Houston area. Visitor spending translates into employment, earnings, and output for the following industries in the Houston region:

- Traveler accommodations (hotels, motels, etc.)
- Food (restaurants, bars, etc.)
- Arts, entertainment, and recreation
- Transportation (ground transportation during the passengers' stay)[7]

[6] The report adjusts visitor spending on ground transportation so that it does not double count airport-related ground transportation with that reported in the passenger spending.

- Other purchases of goods and services

Direct and indirect economic impacts that are spent in the Houston area become earnings for other economic actors in the area.

*Induced* impacts represent the economic effects of the spending and repeated re-spending of these earnings as they cycle through the Houston area economy. These induced impacts are estimated using the Bureau of Economic Analysis of the U.S. Department of Commerce (BEA) RIMS II multipliers, which as a part of this study were developed by the BEA for the ten-county Houston-Sugarland-Baytown metropolitan region.

The following sections describe the methodology and results associated with each of the aforementioned impact categories.

## 3.2 Summary of Methodology

Economic impact studies are conducted to determine the contribution that a facility or sector makes to a region's economy. For airports, economic impact analyses typically measure the impacts of economic activities that result from passenger and cargo transportation by commercial airlines, or non-commercial (general aviation) activity, visitor spending comprised of the local expenditures by air passengers, and the capital investments made at a specific airport.

Generally, an airport's economic impacts stem from air passenger spending within the local region. These impacts include expenditures made at the airport and those for local ground transportation. Industries that are directly impacted by air transportation are industries that support passenger or cargo movements (including their subcontractors). In this analysis, GRA measured direct impacts for industries that directly receive revenues from air passengers or cargo shipments, support activities for airlines and airports, and government and non-commercial entities that support airport activities. The study does not incorporate airline ticket sales; rather it measures the spending by the airline to produce air transportation service in the region.

For entities operating at an airport, the number of employees, total earnings, and the total annual sales or budget of the entity contribute to the direct impact of the airport. These data were collected through a web-based survey of companies identified by HAS. The survey results were supplemented by other databases, which provided employment figures, earnings figures, and/or total sales/budget levels. In some cases, estimates were made based upon data provided by HAS, some activity-level measurements and company size measurements. HAS also provided data on airport concessions and the budgets for airport related public services.

The indirect visitor spending impacts were estimated using passenger statistics for IAH and HOU, such as the distribution of origin-destination passengers and connecting passengers, and tourism data for the Houston region developed by the Greater Houston Convention & Visitors Bureau. Local air visitors were estimated using GRA aviation forecasts, U.S. DOT air

[7] TNS Houston Visitor Profile, 2009

carrier statistics and general aviation operations statistics for the three HAS airports. Average visitor expenditures were estimated using the Houston area tourism data, which allowed the separation of visitors by both trip duration and trip purpose. (It was found, at the margin, that business visitors to the Houston region tend to spend considerably more than leisure visitors, for example.) Using these sources, GRA allocated traveler spending to various travel-related industries (e.g., "Traveler Accommodations"). These categorized expenditures were used to represent the gross sales of the various industries, and, subsequently, earnings and employment were estimated using industry statistics from numerous sources, such as the Department of Labor and the U.S. Economic Census.

Induced impacts were derived from the direct and indirect impacts using industry-specific BEA RIMS-II multipliers for the 10-county Houston MSA, which were acquired for the study from the BEA.

The estimated impacts are based on the calendar year 2009 airport activity levels, and industrial input-output statistics from 2007.

## 3.3 Direct Impact of Air Transportation and Airport-Related Industries

Air transportation provides rapid long distance travel for leisure and business travelers. It also enables high-value, time-sensitive cargo to be rapidly available over great distances, allowing supply chains to become more spread out and locationally efficient. Commercial air transportation services at HAS airports are provided by both scheduled and charter airlines, with support from other industries such as local ground transportation, passenger and cargo processing, airport operations, and airport concessions. Other airport users include public and private non-commercial aircraft operators, flight schools, general aviation pilots and passengers, military aviation units and bases, and firms related to the aviation and space industries, such as fixed base operators serving general aviation or aviation caterers serving commercial carriers.

GRA used the following steps to estimate the direct impacts of air transportation and related industries at HAS airports:

- Identify the industries operating on airport grounds or dependent on airport services.
- Identify the companies and organizations in these industries.
- Survey these companies for employment, earnings, and budget/output levels.[8]
- Develop total direct employment statistics and compare employment levels to HAS badging database.
- Estimate missing data for partial or non-respondents to the survey and follow up efforts.
- Estimate total and induced impacts based upon BEA RIMS-II multipliers.

[8] Surveys were conducted using email contacts with links to online survey tools. Follow up contacts were pursued by email and telephone.

### 3.3.1 Identification of Industry and Other Contacts

The following industries were identified as having direct impacts in the region based upon commercial aircraft activities at HAS airports:

- Airlines (includes all scheduled passenger airlines, their on-airport employees, airline maintenance personnel, and scheduled airline ground crews, as well as based flight and cabin crews for Continental and Southwest airlines and Continental Airlines headquarters functions in Houston)
- Airport Passenger Services (includes airport concessions such as restaurants and shops, currency exchanges, and baggage carts)
- Airport and Aircraft Services (includes fuel services, aircraft maintenance shops, airport maintenance, and avionics shops)
- Passenger Ground Transportation (includes airport parking lots and other ground transportation not included in visitor spending)
- Cargo Services (includes all scheduled cargo airlines, freight forwarders, and non-scheduled charter cargo flight providers)
- Non-Airlines Aircraft Services (includes flight schools, fixed base and corporate aircraft operators and other general aviation users)
- Government (includes all federal, state and local government services and users on or associated with the airports), such as HAS staff, police and fire services, Transportation Security Administration, FAA and customs and immigration, among others)
- Department of Defense activities (includes all aviation related Department of Defense activities on the airports)

For the above categories, GRA identified individual companies or entities for each of the three airports based upon the following sources, and using industrial classifications where available:

- HAS badging data
- Houston Airport System Telephone Directory
- Airport stakeholder lists and other contacts
- Other organization contacts through interviews with Houston Airport System staff

A total of 350 survey contacts were identified for the HAS airports from these sources. For each entity GRA identified a specific point of contact using HAS or other data.

### 3.3.2 Industry Survey

The GRA team constructed industry-specific surveys to determine employment, earnings, and overall sales/budget information for every contact. These were developed in draft form, and tested and modified as necessary. The surveys were distributed through the use of a web-based tool where the respondents responded online. The data requested included both full-time and part-time employment, wages and earnings paid to employees, and total revenue figures.

The study team, assisted by economics graduate students at the University of Houston, contacted individual companies via telephone and e-mail, and in some cases conducted multiple follow-up calls to the respective contacts to attain additional survey respondents. While response rates were low, respondents provided sufficient data for reasonable estimates to be produced, using survey data and supplemental information obtained from HAS or other sources.

### 3.3.3 Direct Employment Estimates

Total employment for the selected entities was estimated from the survey results, secondary source data, Houston Airport System contacts, and the HAS badging database. At times, adjustments or estimations were made to the employment figures to account for discrepancies or missing data. The following adjustments were made:

- Airlines that conduct operations at more than one Houston Airport System airport had their employment figures allocated based upon CY2009 passenger traffic.
- The two largest airlines, Continental and Southwest, provided employment and other data for all activities in the Houston region.
- Military personnel estimates were adjusted to average full-time equivalent employees from part-time employee counts. This was necessary because of the large numbers of reservists who are in drill status.
- Employment for taxi and limousine transportation was projected based upon Houston Airport System badge counts for taxi or limousine-related businesses.
- Total employment for off-airport parking was taken from the ACI Survey information provided by Houston Airport System, and consequently off-airport parking providers were not surveyed.

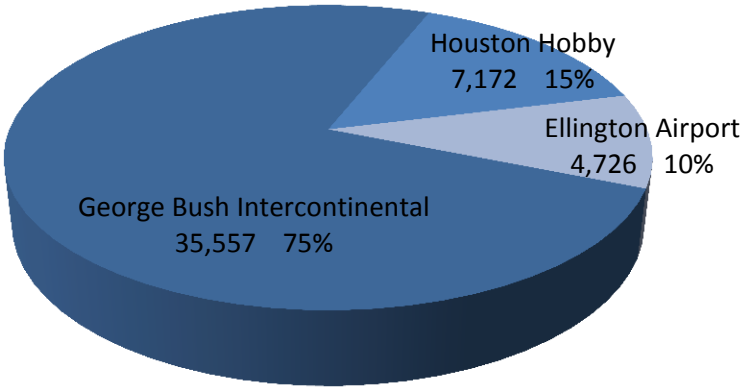
Table 5 shows that the estimated direct employment impacts for air transportation and related industries total 47,455 full time equivalent jobs, including 35,557 at IAH, 7,176 at HOU, and 4,726 at EFD. We found that airlines account for 51 percent of total direct jobs.

**Table 5: Direct Employment by Sector**

| | George Bush Intercontinental | Houston Hobby | Ellington Airport |
|---|---|---|---|
| Airlines | 21,574 | 2,924.0 | |
| Airport Passenger Services | 848 | 451.0 | |
| Passenger Ground Transportation | 4,989 | 2,204.2 | |
| Airport and Aircraft Services | 1,440 | 308.0 | 61.0 |
| Cargo Services | 2,528 | | |
| Non-Airlines Aircraft Operations | 179 | 47.0 | 62.0 |
| Government | 2,418 | 1,058.9 | 527.2 |
| Dept. of Defense | | | 4,028.0 |
| Average Annual CIP | 1,582 | 178.5 | 48.3 |
| **Total** | **35,557** | **7,171.6** | **4,726.5** |

Figure 6 shows the distribution of direct employment for each of the three airports. As can be seen IAH accounts for three-fourths of direct employment, HOU for 15 percent and EFD for 10 percent. The vast majority of employment at Ellington is for the airport dependent military and government activities at the airport.

**Figure 6: Direct Employment by Airport**




### 3.3.4 Direct Earnings and Output Effects

Direct earnings and output impacts were estimated for commercial airports based upon survey data, and government statistics for industries in the Houston Metropolitan Statistical Area. GRA, Incorporated used the following processes:

- The impacted entities were categorized using the North American Industrial Code System (NAICS).
- Surveys were sent to all points of contact seeking data for employment, employee earnings and output.
- If there was no response to a survey, average employee wages were estimated using the 2007 Economic Census for the specific NAICS-code, and then multiplied by the total number of employees (from HAS badging or other data) to generate a total wage bill.
- Using the 2007 Economic Census, GRA obtained the "Total Revenue Size of Establishment" value for each NAICS code. GRA then calculated the Economic Census's ratio of "Total Revenue Size of Establishment" to "Total Employment Size of Establishment." Using this ratio, GRA was able to estimate the total output for each entity.
- Using the U.S. Bureau of Economic Analysis Regional Economic Data, GRA was able to develop a total *earnings* measure for each point of contact.[9]

[9] Earnings include the sum of all wages and salary disbursements, supplements to wages and salaries, and proprietor's income.

## 3.4 Visitor Expenditure Impacts

The numbers of air visitors to Houston were estimated for both commercial and general aviation. For commercial aviation, the share of arriving passengers who indicated they resided outside of the region on the HAS survey were the basis for estimating air visitors for both IAH and HOU. We divided them among business and leisure travelers using the results from the TNS survey. We then estimated visitor-spending using the TNS data discussed below.

### 3.4.1 Commercial Airline Visitors

Visitors travel to Houston for a variety of reasons. The trip purpose for the vast majority is leisure, with nearly 79 percent of all visitors listing their primary trip purpose as "*Leisure/Personal*" in the 2009 TNS Houston Visitor Profile, while 18 percent of travelers list "*Business*" as their primary trip purpose. Leisure travel includes tourists, travelers visiting friends and relatives and other needs. The peak travel months for the Houston region are April through June, with a large increase in the number of visitors in April followed by a decrease in visitors in late June/early July.

Air transportation is a valuable tool for long-distance travel between city pairs. Houston's commercial airports are essential for bringing tourist, business, and other visitors to the Houston region, especially those travelling long distances. The "indirect impact" of airport visitor expenditures on the local economy was measured based upon passenger characteristics and spending patterns for air visitors. The methodology is summarized below:

- Passenger statistics were used to estimate the total number of passengers passing through the Houston Airport System airports. Coupled with the GRA forecasts for the Houston region, GRA was able to estimate the number of origin/destination passengers and connecting passengers through each Houston Airport System airport.
- Using the number of origin/destination passengers, GRA estimated the number of Houston residents, U.S. Non-Houston residents, and International visitors to the region from the Houston Airport System terminal passenger surveys. Subsequently, using the TNS Houston Visitor Profile, GRA separated the U.S. Non-Houston residents by originating region, enabling a more accurate measure of visitor spending, as passengers from different regions typically have different spending patterns.[10]
- The passengers were then separated by trip purpose—business or leisure, and by type of trip—day or overnight. All international visitors were assumed to be overnight passengers. Additionally, since the TNS Houston Visitor Profile did not provide separate visitor spending profiles for international visitors, business overnight spending (the maximum spending category) was used.
- All sectors of visitor spending (hotel, transportation, shopping, arts and entertainment, and other) were calculated using the TNS Houston Visitor Profile.

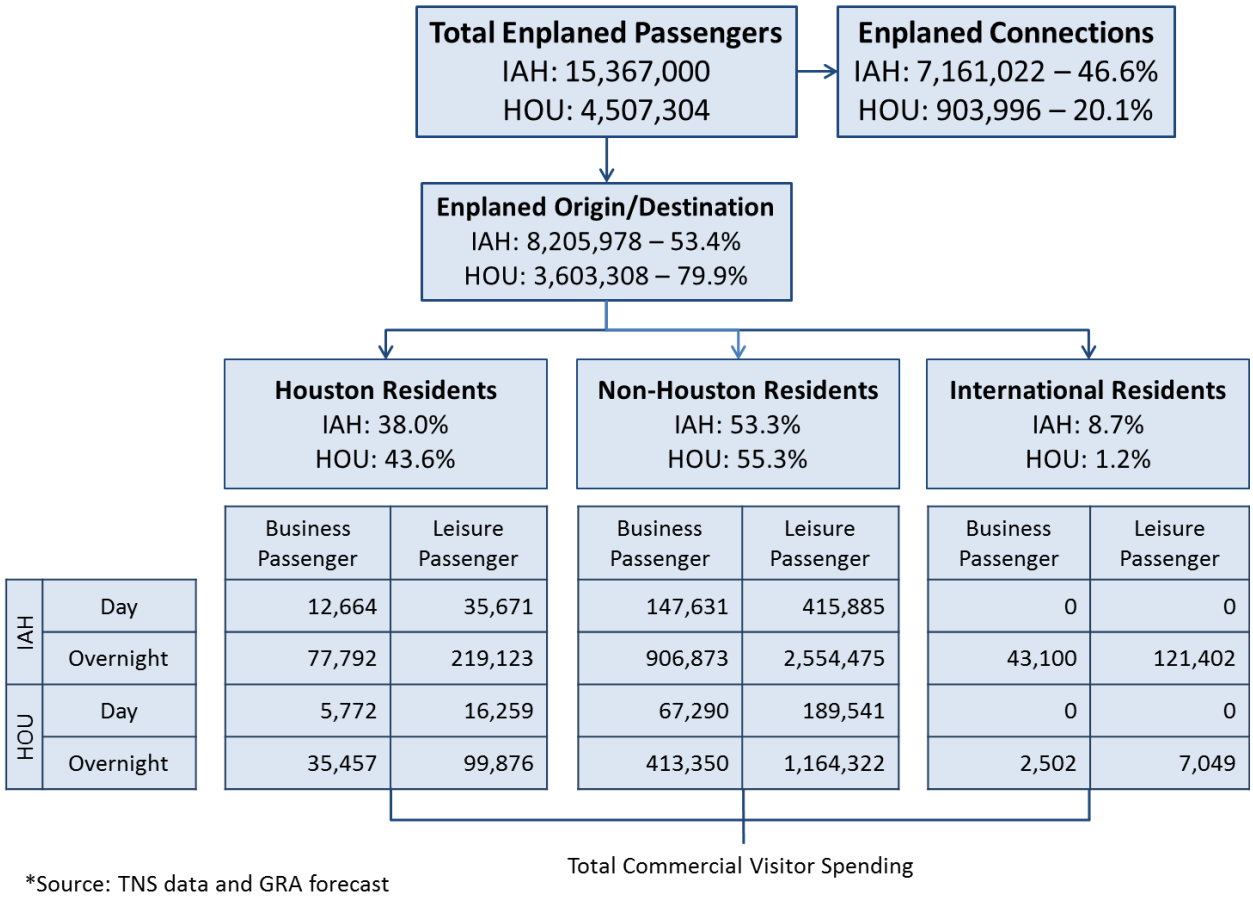
The typical visitor to the Houston region arrives in an average party size of 2.7 individuals, and 27 percent of travelers arrive with children. The majority of visitors to the

[10] FAA regions were used to categorize where visitors came from.

Houston region stay overnight, and the average duration of stay is 3.4 days. On average, 1.2 nights, are spent in hotel or other commercial lodging establishment. (It is also notable that, while a significant share of Houston's visitors arrive by air, the majority tends to arrive in Houston via automobile.)

Figure 7 summarizes the approach to estimating commercial visitor spending. We started with figures for total enplanements because we are concerned with trips rather than total annual passengers, which counts both arriving and departing passengers. Data on residency was attained from TNS surveys and the business vs. leisure breakdown was attained from surveys provided by HAS. For a more complete view of commercial visitor spending calculations, please see Appendix Table 1.

**Figure 7: Visitor Profile Summary**




| | | Houston Residents | | Non-Houston Residents | | International Residents | |
|---|---|---|---|---|---|---|---|
| | | Business Passenger | Leisure Passenger | Business Passenger | Leisure Passenger | Business Passenger | Leisure Passenger |
| IAH | Day | 12,664 | 35,671 | 147,631 | 415,885 | 0 | 0 |
| IAH | Overnight | 77,792 | 219,123 | 906,873 | 2,554,475 | 43,100 | 121,402 |
| HOU | Day | 5,772 | 16,259 | 67,290 | 189,541 | 0 | 0 |
| HOU | Overnight | 35,457 | 99,876 | 413,350 | 1,164,322 | 2,502 | 7,049 |

*Source: TNS data and GRA forecast

Overnight leisure visitors spend nearly twice as much as day-trip visitors, according to the TNS Houston Visitor Profile ($446 vs. $196, respectively). However, since day visitors do not have lodging expenses, day trip visitors also spend a greater portion of their travel budget on shopping and entertainment than overnight visitors (20 percent, vs. 9 percent, respectively). Finally, the average length of stay is longer for a leisure traveler than a business traveler; however, business travelers spend a greater portion of their travel budget on lodging.

### 3.4.2 General Aviation

GRA used the same core spending data for calculating the economic impact of visitor expenditures by general aviation passengers as by commercial passengers, mentioned previously. General aviation passenger counts were derived from GRA analysis of FAA Enhanced Traffic Management System (ETMS) data for HOU and IAH.[11] These data report all IFR flights and account for almost all GA activity at these two airports. Data on specific aircraft make-models were used to estimate passengers on board each flight. For GA visitors we assumed that 50% of the flights were for visitors to the region. For Ellington Airport we applied national averages for GA flights to estimate air visitors because the FAA ETMS flight data only covers a small share of EFD flights. All general aviation passengers were assigned "business overnight" as a passenger expense category using the TNS Houston Visitor Profile, because general aviation passengers are likely to spend more than other travelers. Detailed estimates of GA visitor spending are shown in Table 1.

### 3.4.3 Total Visitor Spending

Annual total visitor expenditure impacts for all passengers were estimated using the RIMS-II multipliers for the Houston travel/tourism and related sectors. Table 6 shows total visitor spending for the HAS airports. The spending produces a total output impact of $7.7 billion. Overall visitor spending supports a total employment impact of over 90,000 jobs with earnings in excess of $3.3 billion.

**Table 6: Total Impacts of Visitor Expenditures by Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Bush Intercontinental | 61,903 | $1,598.0 | $5,284.8 |
| Houston Hobby | 27,800 | $721.6 | $2,388.2 |
| Ellington Airport | 496 | $13.4 | $44.4 |
| **Total** | **90,199** | **$2,333.0** | **$7,717.4** |

Figure 8 shows the distribution of spending for all visitors at the three HAS airports, and includes both commercial and general aviation visitors. As can be seen the largest categories of spending are for ground transportation, lodging and food.

[11] General aviation passenger enplanements are not tracked at the airport level. Most studies apply national averages to estimate passengers and derive visitor spending.

**Figure 8: Economic Impact of Visitor Spending on Commercial Activities ($mil)**

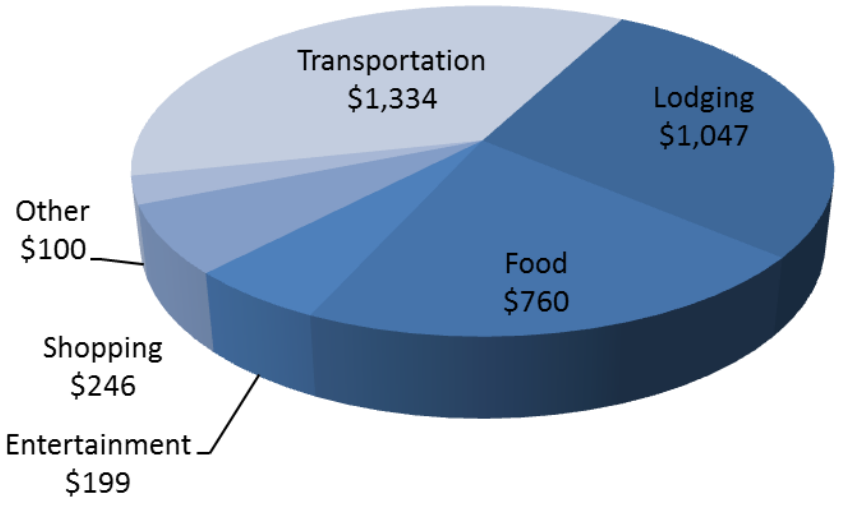
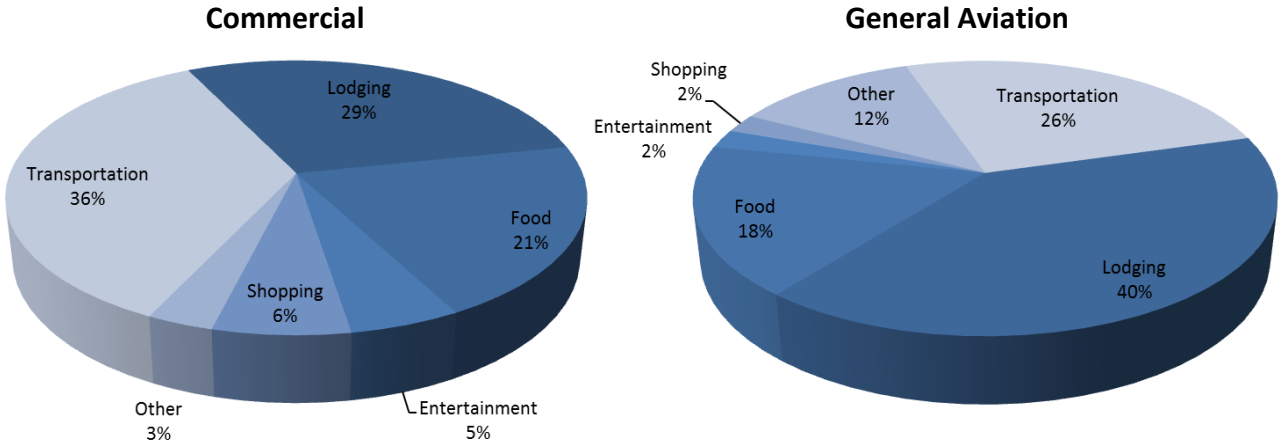



Figure 9 shows spending disaggregated by commercial and general aviation visitors to the region. GA passengers spend a higher share on lodging because they are all treated as business travelers.

**Figure 9: Economic Impact of Visitor Spending on General Aviation Related Activities**

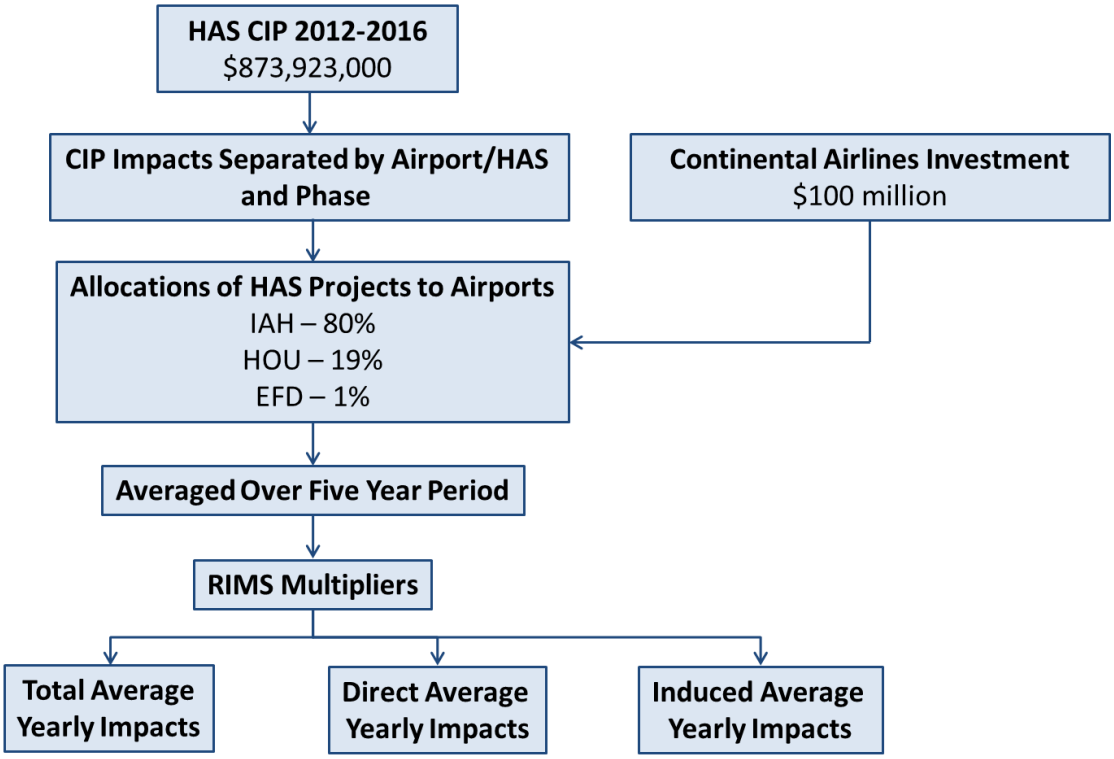



## 3.5 Capital Improvement Program Impacts

Major commercial airports necessitate large investments for improvements to infrastructure, facilities, and airport related equipment. Each year, airports undertake various capital improvement programs (CIPs) such as runway improvements, facility rehabilitations and terminal expansions. These CIPs in turn employ people in the fields of construction, engineering, architecture and consulting. Investments in airport design and construction have a major impact

on the local economy and are necessary to include in the estimation of an airport's regional economic impact. Figure 10 details the methodology concerning the impacts from capital improvement programs:

**Figure 10: CIP Impact Methodology**




- HAS provided annual CIP expenditures for the years 2012 through 2016.
- The expenditures were broken out by airport (IAH, HOU, EFD) and by phase (construction, design, construction management, construction and design, design and build, land acquisition and other CIP related activities).
- Expenditures from a separate HAS category were distributed to the three airports based on the following rule: 80% to Bush Intercontinental, 19% to Houston Hobby and the remaining 1% to Ellington Airport
- CIP data also includes $100 million in construction-related spending by Continental Airlines over the same five year period. This expenditure was added to the construction sector at Bush Intercontinental.
- Data for each sector and the Continental Airlines Expenditure were averaged over the five year period to smooth out any peak or trough in construction-related activity.
- Impacts were estimated using BEA guidance on estimating the impact based on the change in final demand.

- Total impacts were estimated using BEA RIMS II final demand multipliers.[12] Direct impacts were estimated using RIMS II direct multipliers.[13] Induced impacts were calculated by taking the difference between total and direct impacts
- The resulting total, direct and induced impacts report the CIP-related impacts each year over the 2012-2016 period.
- The RIMS categories used are detailed in table 8 below.

**Table 8: RIMS Categories**

| Description | RIMS Category |
|---|---|
| Construction | Construction |
| Design | Professional, scientific, and technical services |
| Construction management | Professional, scientific, and technical services |
| Both Construction and Design | Construction |
| Design/Build | Professional, scientific, and technical services |
| Land Acquisition | Real Estate |
| Other | Other |

A summary of the impacts from capital improvement programs is described below. For a more detailed look at these impacts, see the Capital Improvement Program Methodology (section 3.4) or Appendix tables 7-11.

Table 9 below shows the average yearly total, direct and induced impacts for each airport over the five year period.[14] Houston Airport System airports combine to produce $433.7 million in total output per year over the 2012-2016 period. Direct output for the combined airports is $194.8 million per year over the five year period and induced output for the three airports is $239 million per year over the same period.

[12] For total output, the RIMS multipliers represent the total dollar change for each additional dollar of output delivered to final demand by the industry corresponding to the entry. For total earnings, the RIMS multipliers represent the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry. For total employment, the RIMS multipliers represent the total change in the number of jobs that occurs in all industries for each additional one million dollars of output delivered to final demand by the industry corresponding to the entry.

[13] For direct earnings, the RIMS multipliers represent the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry for each industry corresponding to the entry. For direct employment, the RIMS multipliers represent the total change in the number of jobs in all industries for each additional job in the industry corresponding to the entry.

[14] Some CIP impacts may already be reflected in the total impacts; however, because of the size of the CIP impacts relative to the total impacts, removal of the already-included impacts would be negligible

**Table 9: Average Yearly Total, Direct and Induced Impacts from CIP Expenditures 2012-2016**

| | Total ($mil) | Direct ($mil) | Induced ($mil) |
|---|---|---|---|
| Bush Intercontinental* | $381.6 | $171.6 | $210.0 |
| Houston Hobby | $40.8 | $18.1 | $22.7 |
| Ellington Airport | $11.3 | $5.0 | $6.3 |
| **Total** | **$433.7** | **$194.8** | **$239.0** |

*Includes CIP investment from Continental Airlines

Table 10 below details the average yearly total (i.e. not broken out by sector) impacts for each of the HAS airports. Overall, investments in CIPs are estimated to produce $433.7 million in output, $147.7 million in earnings and generate 3,737 jobs each year over the 2012-2016 period. Bush Intercontinental clearly produces the largest impacts at $381.6 million, likely because it includes CIP investments by Continental airlines. Investments in CIPs at Houston Hobby are estimated to generate the second largest impacts across all three categories, with $40.8 million in output generated, $13.6 million in earnings generated and 359 jobs each year over the five year period. CIP expenditures at Ellington Airport are estimated to generate $11.3 million in output, $3.8 million in earnings and produce 98 jobs each year over the five year period. CIP impacts broken out by sector and by airport are detailed in Appendix tables 7-11.

**Table 10: Average Yearly Total Impacts from CIP Expenditures by Airport 2012-2016**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Bush Intercontinental* | 3,279.7 | $130.3 | $381.6 |
| Houston Hobby | 358.6 | $13.6 | $40.8 |
| Ellington Airport | 98.3 | $3.8 | $11.3 |
| **Total** | **3,736.6** | **$147.7** | **$433.7** |

*Includes CIP investment from Continental Airlines

## 3.6 Induced Impacts of Air Transportation and Airport-Related Industries

Direct impacts generate additional impacts throughout the local economy, as directly impacted industries and employees make purchases from local businesses. *Induced* impacts measure these purchases, and are estimated using multipliers developed for the Houston metropolitan area by the Bureau of Economic Analysis. The multipliers are applied to the direct output of each industry sector, and consequently produce total impacts from which induced impacts are calculated.

We will use the airline sector at Houston Hobby Airport to illustrate this process and the calculation of induced impacts. The airline sector at HOU contributes 2,924 jobs, $251,462,740 in earnings, and $453,893,819 in total output to direct economic impacts for the Houston Airport System. Using the RIMS-II direct impact multipliers, we derive the total economic effects of the

industry. First, we use the direct output multiplier for air transportation of 2.3004, and multiply this value by the total direct output, $453,893,819. This generates $1,044,137,342 in total economic impacts. Using the payroll RIMS-II multiplier of 2.0554 for air transportation, we find that the total earnings for the industry is $516,856,516 ($251,462,740 *2.0554). Employment is calculated in a similar fashion, using the employment multiplier of 2.9193, and thus generating total employment of 8,536 (2,924 * 2.9193).

Now that we have calculated total impacts, we are able to solve for induced economic impacts. First, note that:

$$Total\ Impacts = Direct\ Impacts + Indirect\ Impacts + Induced\ Impacts.$$

The airline industry, however, does not have an indirect impact sector. Therefore, rewriting the previous equation to solve for induced impacts, we see that

$$Induced\ Impacts = Total\ Impacts - Direct\ Impacts.$$

Using this method, we calculated the induced impacts of the airline sector where the induced impacts are $590,243,523 in output ($1,044,137,342 - $453,893,819), $265,393,776 in earnings ($516,856,516 - $251,462,740), and 5,612 jobs (8,536 - 2,924). This same method is used for all industries to calculate the induced economic impacts.

Table 7 shows the induced impacts on employment, earnings and output for each airport. The induced output impact at Bush Intercontinental totaled over $12.4 billion, while the induced earnings impact was over $3.5 billion and the induced employment impact was 103,720 jobs. At Houston Hobby, the induced output impact was over $2.4 billion, the induced earnings impact was over $894 million and the induced employment impact was 30,269 jobs. The induced output impact Ellington Airport was over $339 million, while the induced earnings impact was over $157 million and the induced employment impact was 5,123 jobs.

**Table 7: Induced Impacts by Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Bush Intercontinental | 103,720 | $3,541.1 | $12,459.9 |
| Houston Hobby | 30,269 | $894.8 | $2,427.9 |
| Ellington Airport | 5,123 | $157.3 | $339.6 |
| **Total** | **139,113** | **$4,593.2** | **$15,227.4** |

In the sections above, we summarized the results of the economic impacts of the Houston Airport System airports on the Houston regional economy. We also described the methodology used in calculating direct impacts, visitor expenditure impacts, induced impacts, capital improvement program impacts and impacts of air transportation on international trade. The next section contains appendix tables which describe our methodology and results in further detail. The final section contains the economic impacts of each of the three HAS airports. Each section

describes the airport's general characteristics, direct and indirect impacts as well as impacts from capital improvement programs.

## 3.7 Impact of Air Transportation on International Trade

Recently completed research at the University of Houston[15] has investigated the links between international air travel at Houston airports and foreign exports passing through Houston ports and airports. This study, which is included as Attachment D, *Report on Trade Facilitation*, in the overall HAS Economic Impact report, examines the statistical relationship between international travel to Houston and subsequent exports from the Houston region. The study concluded that each foreign visitor entering the Houston area using a HAS airport is on average associated with between $1,200 and $1,700 in exports departing the U.S. from facilities in the Houston area.[16]

As reported in Attachment D, these exports could be classified into a variety of commodity types, including agricultural, mining, manufacturing and other goods. With the assumption that 50 percent of these export goods were produced in the Houston region, it was found that Houston region export production associated with international travel at Houston airports had total employment impacts of between 60,871 and 85,320 jobs, providing annual earnings between $2.7 billion and $3.9 billion and resulting in economic output totaling between $11.4 billion and $16.0 billion.

Because these values are developed separately from the methods used for the economic impact estimates gathered directly from airport and airport user sources, they are not reported in combination with the values reported in Table 1 for the Total Economic Impacts associated with the Houston Airport System. Nevertheless, the estimate for Houston-area foreign trade facilitated by international passenger arrivals does represent an important aspect of the role of aviation in the overall performance of the Houston area economy.

The complete study, with detailed economic impact calculations from the relevant Houston region export production, is found in Attachment D, *Report on Trade Facilitation*.

[15] Craig, Steven J. with Paula Arce-Trigatti and Jerrod Hunt. *Report on Trade Facilitation Study*. Department of Economics, University of Houston, June 15, 2011.

[16] The study team was unable to determine what proportion of these exports were produced in the Houston region.

# Appendix: Data Tables

## Appendix Table 1: Average Visitor Spending

**Visitors to Houston Region via Air**

↓

| | | IAH | | HOU | | EFD | |
|---|---|---|---|---|---|---|---|
| | | Business/Int'l | Leisure | Business/Int'l | Leisure | Business/Int'l | Leisure |
| Number of Passengers | Commercial | 1,332,818 | 3,755,934 | 542,066 | 1,492,899 | 0 | 0 |
| | General Aviation | 151,813 | 0 | 363,047 | 0 | 56,992 | 0 |

↓

**Average Visitor Spending per Day**

↓

| | | IAH | | HOU | | EFD | |
|---|---|---|---|---|---|---|---|
| | | Business/Int'l | Leisure | Business/Int'l | Leisure | Business/Int'l | Leisure |
| Average Visitor Spending | Commercial | | | | | | |
| | Lodging | $110.47 | $17.64 | $110.57 | $17.59 | - | - |
| | Food | $49.34 | $32.55 | $49.34 | $32.55 | - | - |
| | Entertainment | $5.48 | $8.45 | $5.48 | $8.45 | - | - |
| | Shopping | $5.48 | $10.90 | $5.48 | $10.90 | - | - |
| | Transportation | $95.94 | $45.86 | $95.94 | $45.86 | - | - |
| | Other | $8.22 | $2.46 | $8.22 | $2.46 | - | - |
| | **Total** | $274.94 | $117.85 | $275.04 | $117.80 | - | - |
| | General Aviation | | | | | | |
| | Lodging | $40.62 | - | $41.96 | - | $42.96 | - |
| | Food | $18.28 | - | $18.88 | - | $19.33 | - |
| | Entertainment | $2.03 | - | $2.10 | - | $2.15 | - |
| | Shopping | $2.03 | - | $2.10 | - | $2.15 | - |
| | Transportation | $35.54 | - | $36.72 | - | $37.59 | - |
| | Other | $3.05 | - | $3.15 | - | $3.22 | - |
| | **Total** | $101.54 | - | $104.91 | - | $107.41 | - |

↓

**Average Length of Stay**

↓

| | | IAH | | HOU | | EFD | |
|---|---|---|---|---|---|---|---|
| | | Business/Int'l | Leisure | Business/Int'l | Leisure | Business/Int'l | Leisure |
| Average Length of Stay | Commercial | 3.4 | 3.7 | 3.4 | 3.7 | 3.4 | 3.7 |
| | General Aviation | 3.4 | 3.7 | 3.4 | 3.7 | 3.4 | 3.7 |

↓

**Average Visitor Spending per Trip**

↓

**Average Visitor Spending per Trip**

↓

| | | | IAH | | HOU | | EFD | |
|---|---|---|---|---|---|---|---|---|
| | | | Business/Int'l | Leisure | Business/Int'l | Leisure | Business/Int'l | Leisure |
| Average Visitor Spending | Commercial | Lodging | $375.61 | $65.26 | $375.93 | $65.10 | - | - |
| | | Food | $167.76 | $120.43 | $167.76 | $120.43 | - | - |
| | | Entertainment | $18.64 | $31.25 | $18.64 | $31.25 | - | - |
| | | Shopping | $18.64 | $40.31 | $18.64 | $40.31 | - | - |
| | | Transportation | $326.20 | $169.68 | $326.20 | $169.68 | - | - |
| | | Other | $27.96 | $9.09 | $27.96 | $9.09 | - | - |
| | | **Total** | **$934.81** | **$436.03** | **$935.13** | **$435.87** | **-** | **-** |
| | General Aviation | Lodging | $138.09 | - | $142.68 | - | $146.07 | - |
| | | Food | $62.14 | - | $64.20 | - | $65.73 | - |
| | | Entertainment | $6.90 | - | $7.13 | - | $7.30 | - |
| | | Shopping | $6.90 | - | $7.13 | - | $7.30 | - |
| | | Transportation | $120.83 | - | $124.84 | - | $127.81 | - |
| | | Other | $10.36 | - | $10.70 | - | $10.96 | - |
| | | **Total** | **$345.23** | **-** | **$356.69** | **-** | **$365.18** | **-** |

↓

**Total Visitor Spending**

↓

| | | | IAH | | HOU | | EFD | |
|---|---|---|---|---|---|---|---|---|
| | | | Business/Int'l | Leisure | Business/Int'l | Leisure | Business/Int'l | Leisure |
| Total Visitor Spending | Commercial | Lodging | $500,618,128 | $ 245,116,978 | $203,778,340 | $97,186,902 | - | - |
| | | Food | $223,593,580 | $ 452,342,767 | $90,936,928 | $179,796,035 | - | - |
| | | Entertainment | $24,843,731 | $ 117,388,565 | $10,104,103 | $46,659,304 | - | - |
| | | Shopping | $24,843,731 | $ 151,414,023 | $10,104,103 | $60,183,655 | - | - |
| | | Transportation | $434,765,295 | $ 637,296,380 | $176,821,804 | $253,310,920 | - | - |
| | | Other | $37,265,597 | $ 34,157,967 | $15,156,155 | $13,577,021 | - | - |
| | | **Total** | **$1,245,930,062** | **$ 1,637,716,680** | **$506,901,433** | **$650,713,837** | **-** | **-** |
| | General Aviation | Lodging | $20,964,446 | - | $51,798,347 | - | $8,324,987 | - |
| | | Food | $9,434,001 | - | $23,309,256 | - | $3,746,244 | - |
| | | Entertainment | $1,048,222 | - | $2,589,917 | - | $416,249 | - |
| | | Shopping | $1,048,222 | - | $2,589,917 | - | $416,249 | - |
| | | Transportation | $18,343,891 | - | $45,323,553 | - | $7,284,364 | - |
| | | Other | $1,572,333 | - | $3,884,876 | - | $624,374 | - |
| | | **Total** | **$52,411,116** | **-** | **$129,495,867** | **-** | **$20,812,467** | **-** |

## Appendix Table 2: Houston Airport System Economic Impact Summary

| | | Direct | | | Indirect | | | Induced | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jobs | Earnings ($mil) | Output ($mil) | Jobs | Earnings ($mil) | Output ($mil) | Jobs | Earnings ($mil) | Output ($mil) | Jobs | Earnings ($mil) | Output ($mil) |
| IAH | Airlines | 21,574 | $1,855 | $5,146 | - | $0 | $0 | 41,408 | $1,958 | $6,692 | 62,982 | $3,814 | $11,838 |
| | Airport Passenger Services | 848 | $20 | $99 | - | $0 | $0 | 1,627 | $21 | $129 | 2,474 | $41 | $227 |
| | Passenger Ground Transportation | 4,989 | $255 | $401 | - | $0 | $0 | 20,218 | $333 | $578 | 25,208 | $588 | $979 |
| | Airport and Aircraft Services | 1,440 | $73 | $164 | - | $0 | $0 | 2,763 | $77 | $213 | 4,203 | $149 | $376 |
| | Cargo Services | 2,528 | $111 | $984 | - | $0 | $0 | 4,852 | $117 | $1,280 | 7,380 | $228 | $2,264 |
| | Non-Airlines Aircraft Operations | 179 | $11 | $89 | - | $0 | $0 | 344 | $12 | $116 | 523 | $23 | $206 |
| | Government | 2,418 | $129 | $425 | - | $0 | $0 | 1,738 | $135 | $470 | 4,155 | $264 | $895 |
| | Dept. of Defense | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Visitor Spending Commercial | 0 | $0 | $0 | 32,189 | $754 | $2,459 | 28,465 | $810 | $2,714 | 60,654 | $1,564 | $5,173 |
| | Visitor Spending General Aviation | 0 | $0 | $0 | 641 | $16 | $52 | 608 | $17 | $59 | 1,249 | $34 | $112 |
| | Construction | 1,582 | $69 | $172 | - | $0 | $0 | 1,698 | $62 | $210 | 3,280 | $130 | $382 |
| | **Total** | **35,557** | **$2,522** | **$7,480** | **32,830** | **$770** | **$2,512** | **103,720** | **$3,541** | **$12,460** | **172,108** | **$6,833** | **$22,451** |
| HOU | Airlines | 2,924 | $251 | $454 | - | $0 | $0 | 5,612 | $265 | $590 | 8,536 | $517 | $1,044 |
| | Airport Passenger Services | 451 | $14 | $33 | - | $0 | $0 | 866 | $14 | $42 | 1,317 | $28 | $75 |
| | Passenger Ground Transportation | 2,204 | $119 | $178 | - | $0 | $0 | 8,998 | $155 | $257 | 11,202 | $274 | $435 |
| | Airport and Aircraft Services | 308 | $19 | $55 | - | $0 | $0 | 591 | $20 | $71 | 899 | $39 | $126 |
| | Cargo Services | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Non-Airlines Aircraft Operations | 47 | $3 | $8 | - | $0 | $0 | 90 | $3 | $11 | 137 | $6 | $19 |
| | Government | 1,059 | $54 | $160 | - | $0 | $0 | 761 | $57 | $177 | 1,820 | $111 | $337 |
| | Dept. of Defense | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Visitor Spending Commercial | 0 | $0 | $0 | 13,045 | $308 | $1,002 | 11,668 | $331 | $1,110 | 24,714 | $639 | $2,112 |
| | Visitor Spending General Aviation | 0 | $0 | $0 | 1,584 | $40 | $129 | 1,502 | $43 | $147 | 3,086 | $83 | $276 |
| | Construction | 178 | $7 | $18 | - | $0 | $0 | 180 | $7 | $23 | 359 | $14 | $41 |
| | **Total** | **7,172** | **$467** | **$906** | **14,629** | **$348** | **$1,131** | **30,269** | **$895** | **$2,428** | **52,069** | **$1,710** | **$4,465** |
| EFD | Airlines | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Airport Passenger Services | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Passenger Ground Transportation | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Airport and Aircraft Services | 61 | $2 | $13 | - | $0 | $0 | 117 | $2 | $17 | 178 | $5 | $29 |
| | Cargo Services | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Non-Airlines Aircraft Operations | 62 | $2 | $13 | - | $0 | $0 | 119 | $2 | $17 | 181 | $5 | $31 |
| | Government | 527 | $28 | $77 | - | $0 | $0 | 379 | $30 | $85 | 906 | $58 | $162 |
| | Dept. of Defense | 4,028 | $109 | $173 | - | $0 | $0 | 4,217 | $114 | $191 | 8,245 | $223 | $364 |
| | Visitor Spending Commercial | 0 | $0 | $0 | - | $0 | $0 | 0 | $0 | $0 | 0 | $0 | $0 |
| | Visitor Spending General Aviation | 0 | $0 | $0 | 255 | $6 | $21 | 241 | $7 | $24 | 496 | $13 | $44 |
| | Construction | 48 | $2 | $5 | - | $0 | $0 | 50 | $2 | $6 | 98 | $4 | $11 |
| | **Total** | **4,726** | **$144** | **$281** | **255** | **$6** | **$21** | **5,123** | **$157** | **$340** | **10,104** | **$308** | **$641** |
| Total | Airlines | 24,498 | $2,107 | $5,600 | - | $0 | $0 | 47,020 | $2,224 | $7,282 | 71,518 | $4,330 | $12,882 |
| | Airport Passenger Services | 1,299 | $33 | $131 | - | $0 | $0 | 2,492 | $35 | $171 | 3,791 | $69 | $302 |
| | Passenger Ground Transportation | 7,193 | $374 | $579 | - | $0 | $0 | 29,216 | $488 | $834 | 36,410 | $861 | $1,414 |
| | Airport and Aircraft Services | 1,809 | $94 | $231 | - | $0 | $0 | 3,471 | $99 | $301 | 5,280 | $193 | $532 |
| | Cargo Services | 2,528 | $111 | $984 | - | $0 | $0 | 4,852 | $117 | $1,280 | 7,380 | $228 | $2,264 |
| | Non-Airlines Aircraft Operations | 288 | $16 | $111 | - | $0 | $0 | 553 | $17 | $144 | 841 | $33 | $255 |
| | Government | 4,004 | $211 | $662 | - | $0 | $0 | 2,878 | $221 | $732 | 6,882 | $433 | $1,394 |
| | Dept. of Defense | 4,028 | $109 | $173 | - | $0 | $0 | 4,217 | $114 | $191 | 8,245 | $223 | $364 |
| | Visitor Spending Commercial | 0 | $0 | $0 | 45,234 | $1,062 | $3,461 | 40,134 | $1,141 | $3,824 | 85,368 | $2,203 | $7,285 |
| | Visitor Spending General Aviation | 0 | $0 | $0 | 2,479 | $63 | $203 | 2,352 | $67 | $230 | 4,831 | $144 | $432 |
| | Average Annual CIP | 1,809 | $78 | $195 | - | $0 | $0 | 1,928 | $70 | $239 | 3,737 | $148 | $434 |
| | **Total** | **47,456** | **$3,133** | **$8,667** | **47,713** | **$1,125** | **$3,664** | **139,113** | **$4,593** | **$15,227** | **234,281** | **$8,865** | **$27,558** |

## Appendix Table 3: Indirect and Total Impacts from Visitor Expenditures

| | Factors/ Multipliers | IAH | HOU | EFD | Combined Total |
|---|---|---|---|---|---|
| **Lodging** | | | | | |
| **Impact Factors** | Factors | | | | |
| Ratio of Revenues to Earnings | 3.51 | | | | |
| Average Earnings per Employee | $ 24,020 | | | | |
| **Indirect Impacts** | | | | | |
| Expenditures (000 $) | | $766.7 | $352.8 | $8.3 | $1,127.8 |
| Earnings (000 $) | | $218.6 | $100.6 | $2.4 | $321.6 |
| Employment | | 9,102 | 4,188 | 99 | 13,389 |
| **Total Impacts** | Multipliers | | | | |
| Expenditures (000 $) | 1.9262 | $1,476.8 | $679.5 | $16.0 | $2,172.3 |
| Earnings (000 $) | 0.5818 | $446.1 | $205.2 | $4.8 | $656.1 |
| Employment | 19.6996 | 15,104 | 6,949 | 164 | 22,217 |
| **Food** | | | | | |
| **Impact Factors** | Factors | | | | |
| Ratio of Revenues to Earnings | 3.22 | | | | |
| Average Earnings per Employee | $ 13,961 | | | | |
| **Indirect Impacts** | | | | | |
| Expenditures (000 $) | | $685.4 | $294.0 | $3.7 | $983.1 |
| Earnings (000 $) | | $212.6 | $91.2 | $1.2 | $305.0 |
| Employment | | 15,229 | 6,534 | 83 | 21,846 |
| **Total Impacts** | Multipliers | | | | |
| Expenditures (000 $) | 2.0277 | $1,389.7 | $596.2 | $7.6 | $1,993.5 |
| Earnings (000 $) | 0.6111 | $418.8 | $179.7 | $2.3 | $600.8 |
| Employment | 29.4183 | 20,162 | 8,650 | 110 | 28,922 |

| | Factors/ Multipliers | IAH | HOU | EFD | Combined Total |
|---|---|---|---|---|---|
| **Entertainment** | | | | | |
| **Impact Factors** | Factors | | | | |
| Ratio of Revenues to Earnings | 3.25 | | | | |
| Average Earnings per Employee | $ 36,464 | | | | |
| **Indirect Impacts** | | | | | |
| Expenditures (000 $) | | $143.3 | $59.4 | $0.4 | $203.1 |
| Earnings (000 $) | | $44.1 | $18.3 | $0.1 | $62.5 |
| Employment | | 1,209 | 501 | 4 | 1,714 |
| **Total Impacts** | Multipliers | | | | |
| Expenditures (000 $) | 2.0576 | $294.8 | $122.1 | $0.9 | $417.8 |
| Earnings (000 $) | 0.6453 | $92.5 | $38.3 | $0.3 | $131.1 |
| Employment | 28.0959 | 4,026 | 1,668 | 12 | 5,706 |
| **Shopping** | | | | | |
| **Impact Factors** | Factors | | | | |
| Ratio of Revenues to Earnings | 3.66 | | | | |
| Average Earnings per Employee | $ 42,511 | | | | |
| **Indirect Impacts** | | | | | |
| Expenditures (000 $) | | $177.3 | $72.9 | $0.4 | $250.6 |
| Earnings (000 $) | | $48.4 | $19.9 | $0.1 | $68.4 |
| Employment | | 1,138 | 468 | 3 | 1,609 |
| **Total Impacts** | Multipliers | | | | |
| Expenditures (000 $) | 1.9453 | $344.9 | $141.8 | $0.8 | $487.5 |
| Earnings (000 $) | 0.621 | $110.1 | $45.3 | $0.3 | $155.7 |
| Employment | 22.0186 | 3,904 | 1,605 | 9 | 5,518 |

## Indirect and Total Impacts from Visitor Expenditures (continued)

| | Factors/ Multipliers | IAH | HOU | EFD | Combined Total |
|---|---|---|---|---|---|
| **Transportation** | | | | | |
| **Impact Factors** | Factors | | | | |
| Ratio of Revenues to Earnings | 2.81 | | | | |
| Average Earnings per Employee | $ 41,524 | | | | |
| **Indirect Impacts** | | | | | |
| Expenditures (000 $) | | $631.9 | $307.1 | $7.3 | $946.3 |
| Earnings (000 $) | | $225.2 | $109.5 | $2.6 | $337.3 |
| Employment | | 5,424 | 2,636 | 63 | 8,123 |
| **Total Impacts** | Multipliers | | | | |
| Expenditures (000 $) | 2.4401 | $1,541.8 | $749.4 | $17.8 | $2,309.0 |
| Earnings (000 $) | 0.7275 | $459.7 | $223.4 | $5.3 | $688.4 |
| Employment | 25.7534 | 16,273 | 7,910 | 188 | 24,371 |

| | Factors/ Multipliers | IAH | HOU | EFD | Combined Total |
|---|---|---|---|---|---|
| **Other** | | | | | |
| **Impact Factors** | Factors | | | | |
| Ratio of Revenues to Earnings | 7.64 | | | | |
| Average Earnings per Employee | $ 21,890 | | | | |
| **Indirect Impacts** | | | | | |
| Expenditures (000 $) | | $73.0 | $32.6 | $0.6 | $106.2 |
| Earnings (000 $) | | $9.5 | $4.3 | $0.1 | $13.9 |
| Employment | | 436 | 195 | 4 | 635 |
| **Total Impacts** | Multipliers | | | | |
| Expenditures (000 $) | 2.105 | $153.7 | $68.7 | $1.3 | $223.7 |
| Earnings (000 $) | 0.6317 | $46.1 | $20.6 | $0.4 | $67.1 |
| Employment | 21.3477 | 1,558 | 696 | 13 | 2,267 |
| **Total-Visitor Impacts** | | | | | |
| **Indirect Impacts** | | | | | |
| Expenditures (000 $) | | $2,478.0 | $1,119.0 | $21.0 | $3,617.0 |
| Earnings (000 $) | | $758.0 | $344.0 | $7.0 | $1,109.0 |
| Employment | | 32,538 | 14,522 | 256 | 47,316 |
| **Total Impacts** | | | | | |
| Expenditures (000 $) | | $5,202.0 | $2,358.0 | $44.0 | $7,604.0 |
| Earnings (000 $) | | $1,573.0 | $713.0 | $13.0 | $2,299.0 |
| Employment | | 61,027 | 27,478 | 496 | 89,001 |

## Appendix Table 4: Airport Impact Industries

| User/Service Provider Category/Type | NAICS Industry | | REIS Link | RIMS Industry | |
|---|---|---|---|---|---|
| **Airlines** | | | | | |
| Scheduled Passenger Carriers | 481111 | Scheduled Air Passenger Transportation | 481 | 481000 | Air Transportation |
| Charter Airlines | 481211 | Nonscheduled Air Passenger Charering | 481 | 481000 | Air Transportation |
| **Airport Passenger Services** | | | | | |
| Food & Beverage | 722 | Food Services and Drinking Places | 722 | 722000 | Food services and drinking places |
| Retail Goods | 4532 | Office Supply, Stationary, & Gift Stores | 453 | 4A0000 | Retail Trade |
| Personal Services | 8121 | Personal Care Services | 812 | 8121000 | Personal Care Services |
| **Airport and Aircraft Services** | | | | | |
| Fuel Services | 48819 | Other Support Activities, Air Transport | 488 | 48A000 | Scenic/sightseeing transport & support activities |
| Aircraft Maintanence | 48819 | Other Support Activities, Air Transport | 488 | 48A000 | Scenic/sightseeing transport & support activities |
| Airport Maintanence | 48819 | Other Support Activities, Air Transport | 488 | 48A000 | Scenic/sightseeing transport & support activities |
| Avionics Shops | 48819 | Other Support Activities, Air Transport | 488 | 48A000 | Scenic/sightseeing transport & support activities |
| In-Flight Catering | 722310 | Food Service Contractors | 722 | 722000 | Food services and drinking places |
| **Passenger Ground Transportation** | | | | | |
| Parking | 81293 | Parking Lots and Garages | 485 | 485A00 | Transit & ground passenger transportation |
| Taxi | 48531 | Taxi Servies | 485 | 485A00 | Transit & ground passenger transportation |
| Limo | 48532 | Limousine Services | 485 | 485A00 | Transit & ground passenger transportation |
| **Cargo Services** | | | | | |
| Scheduled Cargo Carriers | 481112 | Scheduled Freight Air Transportation | 481 | 481000 | Air Transportation |
| Nonscheduled Cargo Charters | 481212 | Nonscheduled Air Freight Chartering | 481 | 481000 | Air Transportation |
| Freight Forwarders | 4885 | Freight Transportation Arrangement | 488 | 48A000 | Scenic/sightseeing transport & transport support activities |
| Other Cargo Services | 488991 | Packing and Crating | 488 | 48A000 | Scenic/sightseeing transport & transport support activities |
| **Non-Airlines Aircraft Services** | | | | | |
| Flight Schools | 611512 | Flight Training | 481 | 481000 | Air Transportation |
| FBO's | 488119 | Other Airport Operations | 488 | 48A000 | Scenic/sightseeing transport & support activities |
| CBO's | 488119 | Other Airport Operations | 488 | 48A000 | Scenic/sightseeing transport & support activities |
| General Aviation Users | 481219 | Other Nonscheduled Air Transportation | 481 | 481000 | Air Transportation |
| **Government** | | | | | |
| Air Traffic Control | 488111 | Air Traffic Control (except military) | 488 | 48A000 | Scenic/sightseeing transport & support activities |
| Houston Airport System | 92L | Public Administration (Local) | 92L | S00A00 | Other government enterprises |
| T.S.A. | 92F | Public Administration (Federal) | 92L | S00A00 | Other government enterprises |
| Fire Protection | 922160 | Fire Protection | 92L | S00A00 | Other government enterprises |
| Local | 92L | Public Administration (Local) | 92L | S00A00 | Other government enterprises |
| State | 92S | Public Administration (State) | 92L | S00A00 | Other government enterprises |
| Federal | 92F | Public Administration (Federal) | 92L | S00A00 | Other government enterprises |
| **Department of Defense** | 928110 | National Security | 92L | S00A00 | Other government enterprises |

## Appendix Table 5: State of Texas Wages and Earnings Data for Aviation Industry – Groups

| Industry Code | User/Service Provider Category/Type | Total Earnings Data | | Wage/ Earnings Ratio | Average Employee Data | | |
|---|---|---|---|---|---|---|---|
| | | Total Earnings | Total Wages | | Employees | Average Earnings | Average Wage |
| | **Airlines** | **$5,273,446,000** | **$3,992,575,000** | **132.081%** | **61,320** | **$85,999** | **$65,110** |
| 801 | Air Transportation | $5,273,446,000 | $3,992,575,000 | 132.081% | 61,320 | $85,999 | $65,110 |
| | **Airport Passenger Services** | **$37,233,825,000** | **$27,251,803,000** | **136.629%** | **814,289** | **$45,726** | **$33,467** |
| 81 | Other Services (except public administration) | $25,355,491,000 | $17,400,096,000 | 145.720% | 553,627 | $45,799 | $31,429 |
| 446 | Health and personal care stores | $2,968,557,000 | $2,780,504,000 | 106.763% | 65,498 | $45,323 | $42,452 |
| 4481 | Clothing Stores | $2,628,310,000 | $2,435,095,000 | 107.935% | 115,122 | $22,831 | $21,152 |
| 801 | Air Transportation | $5,273,446,000 | $3,992,575,000 | 132.081% | 61,320 | $85,999 | $65,110 |
| 805 | Ground Transportation | $1,008,021,000 | $643,533,000 | 156.639% | 18,722 | $53,842 | $34,373 |
| | **Airport and Aircraft Services** | **$135,524,103,000** | **$99,194,188,000** | **136.625%** | **2,239,696** | **$60,510** | **$44,289** |
| 1300 | Management of companies and services | $7,912,946,000 | $7,123,323,000 | 111.085% | 76,461 | $103,490 | $93,163 |
| 1901 | Repair and maintanence | $8,276,268,000 | $4,078,812,000 | 202.909% | 110,259 | $75,062 | $36,993 |
| 2000 | Government and government services | $117,411,846,000 | $86,645,294,000 | 135.509% | 1,982,293 | $59,230 | $43,710 |
| 707 | Gasoline stations | $1,923,043,000 | $1,346,759,000 | 142.790% | 70,683 | $27,207 | $19,054 |
| | **Passenger Ground Transportation** | **$1,008,021,000** | **$643,533,000** | **156.639%** | **18,722** | **$53,842** | **$34,373** |
| 805 | Ground Transportation | $1,008,021,000 | $643,533,000 | 156.639% | 18,722 | $53,842 | $34,373 |
| | **Cargo Services** | **$17,979,560,000** | **$11,778,077,000** | **152.653%** | **361,464** | **$49,741** | **$32,584** |
| 801 | Air Transportation | $5,273,446,000 | $3,992,575,000 | 132.081% | 61,320 | $85,999 | $65,110 |
| 804 | Truck Transportation | $8,729,522,000 | $4,625,871,000 | 188.711% | 182,393 | $47,861 | $25,362 |
| 809 | Couriers and messengers | $1,794,469,000 | $1,340,121,000 | 133.904% | 56,015 | $32,036 | $23,924 |
| 811 | Warehousing and storage | $2,182,123,000 | $1,819,510,000 | 119.929% | 61,736 | $35,346 | $29,472 |
| | **Non-Airlines Aircraft Services** | **$5,273,446,000** | **$3,992,575,000** | **132.081%** | **61,320** | **$85,999** | **$65,110** |
| 801 | Air Transportation | $5,273,446,000 | $3,992,575,000 | 132.081% | 61,320 | $85,999 | $65,110 |
| | **Government** | **$117,411,846,000** | **$86,645,294,000** | **135.509%** | **1,982,293** | **$59,230** | **$43,710** |
| 2000 | Government and government services | $117,411,846,000 | $86,645,294,000 | 135.509% | 1,982,293 | $59,230 | $43,710 |
| | **Department of Defense** | **$117,411,846,000** | **$86,645,294,000** | **135.509%** | **1,982,293** | **$59,230** | **$43,710** |
| 2000 | Government and government services | $117,411,846,000 | $86,645,294,000 | 135.509% | 1,982,293 | $59,230 | $43,710 |

## Appendix Table 6: State of Texas Wages and Earnings Data for Aviation Industry – Groups

| User/Service Provider Category/Type | 2009 Average Annual Wages per Job | Average Earnings | | Average Output | | Direct Impact Multipliers | | |
|---|---|---|---|---|---|---|---|---|
| | | Earnings/ Wages Ratio | Average Earnings per Job | Output/ Wage Ratio | Average Output per Job | Output | Payroll | Employment |
| **Airlines** | | | | | | | | |
| Air Transportation | $65,110 | 1.321 | $85,999 | 5.613 | $365,467 | 2.3004 | 2.0554 | 2.9193 |
| **Airport Passenger Services** | | | | | | | | |
| Other Services (except public administration) | $31,429 | 1.457 | $45,799 | 4.089 | $128,504 | 2.1050 | 2.0468 | 1.7189 |
| Health and personal care stores | $42,452 | 1.068 | $45,323 | 8.236 | $349,635 | 1.9453 | 1.7766 | 1.5370 |
| Clothing Stores | $21,152 | 1.079 | $22,831 | 8.030 | $169,852 | 1.9453 | 1.7766 | 1.5370 |
| Air Transportation | $65,110 | 1.321 | $85,999 | 5.613 | $365,467 | 2.3004 | 2.0554 | 2.9193 |
| Ground Transportation | $34,373 | 1.566 | $53,842 | 2.688 | $92,404 | 2.4401 | 2.3057 | 1.6916 |
| **Airport and Aircraft Services** | | | | | | | | |
| Management of companies and enterprises | $93,163 | 1.111 | $103,490 | 2.389 | $222,563 | 2.1285 | 1.8255 | 2.7310 |
| Repair and maintanence | $36,993 | 2.029 | $75,062 | 3.437 | $127,156 | 2.2475 | 1.8440 | 2.1516 |
| Government and government services | $43,710 | 1.355 | $59,230 | 4.772 | $208,603 | 2.1050 | 2.0468 | 1.7189 |
| Gasoline stations | $19,054 | 1.428 | $27,207 | 30.70 | $584,967 | 1.9453 | 1.7766 | 1.5370 |
| **Passenger Ground Transportation** | | | | | | | | |
| Ground Transportation | $34,373 | 1.566 | $53,842 | 2.688 | $92,404 | 2.4401 | 2.3057 | 1.6916 |
| **Cargo Services** | | | | | | | | |
| Air Transportation | $65,110 | 1.321 | $85,999 | 5.613 | $365,467 | 2.3004 | 2.0554 | 2.9193 |
| Truck Transportation | $25,362 | 1.887 | $47,861 | 3.739 | $94,818 | 2.2994 | 2.3010 | 2.2156 |
| Couriers and messengers | $23,924 | 1.339 | $32,036 | 3.695 | $88,401 | 2.4401 | 2.3057 | 1.6916 |
| Warehousing and storage | $29,472 | 1.199 | $35,346 | 1.164 | $34,320 | 2.1859 | 1.7880 | 1.7942 |
| **Non-Airlines Aircraft Services** | | | | | | | | |
| Air Transportation | $65,110 | 1.321 | $85,999 | 5.613 | $365,467 | 2.3004 | 2.0554 | 2.9193 |
| **Government** | | | | | | | | |
| Government and government services | $43,710 | 1.355 | $59,230 | 4.772 | $208,603 | 2.1050 | 2.0468 | 1.7189 |
| **Department of Defense** | | | | | | | | |
| Government and government services | $43,710 | 1.355 | $59,230 | 4.772 | $208,603 | 2.1050 | 2.0468 | 1.7189 |

## Appendix Table 7: Total Average Yearly Impacts from CIP Expenditures by Sector 2012-2016

| | Total Impacts | | | Direct Impacts | | | Induced Impacts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) |
| Construction* | 2,813.9 | $107.0 | $321.3 | 1,396.9 | $54.6 | $141.7 | 1,416.9 | $52.3 | $179.6 |
| Design | 196.5 | $9.1 | $24.4 | 83.8 | $5.2 | $11.5 | 112.8 | $3.9 | $13.0 |
| Construction Management | 503.0 | $23.4 | $62.6 | 214.3 | $13.4 | $29.3 | 288.6 | $10.0 | $33.2 |
| Construction & Design | 6.2 | $0.2 | $0.7 | 3.1 | $0.1 | $0.3 | 3.1 | $0.1 | $0.4 |
| Design & Build | 94.8 | $4.4 | $11.8 | 40.4 | $2.5 | $5.5 | 54.4 | $1.9 | $6.3 |
| Land Acquisition | 8.0 | $0.2 | $1.7 | 3.8 | $0.1 | $1.1 | 4.2 | $0.2 | $0.5 |
| Other | 114.2 | $3.4 | $11.3 | 66.4 | $1.7 | $5.4 | 47.8 | $1.7 | $5.9 |
| **Total** | **3,736.6** | **$147.7** | **$433.7** | **1,808.8** | **$77.6** | **$194.8** | **1,927.8** | **$70.1** | **$239.0** |

*Includes CIP investment from Continental Airlines

## Appendix Table 8: Average Yearly Impacts from CIP Expenditures by Airport 2012-2016

| | Total Impacts | | | Direct Impacts | | | Induced Impacts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) |
| Bush Intercontinental* | 3,279.7 | $130.3 | $381.6 | 1,582.1 | $68.6 | $171.6 | 1,697.6 | $61.7 | $210.0 |
| Houston Hobby | 358.6 | $13.6 | $40.8 | 178.5 | $7.0 | $18.1 | 180.1 | $6.6 | $22.7 |
| Ellington Airport | 98.3 | $3.8 | $11.3 | 48.3 | $2.0 | $5.0 | 50.1 | $1.8 | $6.3 |
| **Total** | **3,736.6** | **$147.7** | **$433.7** | **1,808.8** | **$77.6** | **$194.8** | **1,927.8** | **$70.1** | **$239.0** |

*Includes CIP investment from Continental Airlines

## Appendix Table 9: Total Average Yearly Impacts from CIP Expenditures at Bush Intercontinental 2012-2016

| | Total Impacts | | | Direct Impacts | | | Induced Impacts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) |
| Construction* | 2,409.3 | $91.6 | $275.1 | 1,196.1 | $46.8 | $121.3 | 1,213.2 | $44.8 | $153.8 |
| Design | 168.5 | $7.8 | $21.0 | 71.8 | $4.5 | $9.8 | 96.7 | $3.3 | $11.1 |
| Construction Management | 503.0 | $23.4 | $62.6 | 214.3 | $13.4 | $29.3 | 288.6 | $10.0 | $33.2 |
| Construction & Design | 4.0 | $0.2 | $0.5 | 2.0 | $0.1 | $0.2 | 2.0 | $0.1 | $0.3 |
| Design & Build | 94.8 | $4.4 | $11.8 | 40.4 | $2.5 | $5.5 | 54.4 | $1.9 | $6.3 |
| Land Acquisition | 8.0 | $0.2 | $1.7 | 3.8 | $0.1 | $1.1 | 4.2 | $0.2 | $0.5 |
| Other | 92.1 | $2.7 | $9.1 | 53.6 | $1.3 | $4.3 | 38.5 | $1.4 | $4.8 |
| **Total** | **3,279.7** | **$130.3** | **$381.6** | **1,582.1** | **$68.6** | **$171.6** | **1,697.6** | **$61.7** | **$210.0** |

* Includes CIP investment from Continental Airlines

## Appendix Table 10: Total Average Yearly Impacts from CIP Expenditures at Houston Hobby 2012-2016

| | Total Impacts | | | Direct Impacts | | | Induced Impacts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) |
| Construction | 316.2 | $12.0 | $36.1 | 157.0 | $6.1 | $15.9 | 159.2 | $5.9 | $20.2 |
| Design | 19.0 | $0.9 | $2.4 | 8.1 | $0.5 | $1.1 | 10.9 | $0.4 | $1.3 |
| Construction & Design | 2.2 | $0.1 | $0.3 | 1.1 | $0.0 | $0.1 | 1.1 | $0.0 | $0.1 |
| Other | 21.2 | $0.6 | $2.1 | 12.3 | $0.3 | $1.0 | 8.9 | $0.3 | $1.1 |
| **Total** | **358.6** | **$13.6** | **$40.8** | **178.5** | **$7.0** | **$18.1** | **180.1** | **$6.6** | **$22.7** |

## Appendix Table 11: Total Average Yearly Impacts from CIP Expenditures at Ellington Airport 2012-2016

| | Total Impacts | | | Direct Impacts | | | Induced Impacts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) | Employment | Earnings ($mil) | Output ($mil) |
| Construction | 88.4 | $3.4 | $10.1 | 43.9 | $1.7 | $4.5 | 44.5 | $1.6 | $5.6 |
| Design | 9.0 | $0.4 | $1.1 | 3.9 | $0.2 | $0.5 | 5.2 | $0.2 | $0.6 |
| Other | 0.9 | $0.0 | $0.1 | 0.5 | $0.0 | $0.0 | 0.4 | $0.0 | $0.0 |
| **Total** | **98.3** | **$3.8** | **$11.3** | **48.3** | **$2.0** | **$5.0** | **50.1** | **$1.8** | **$6.3** |

# Attachment A: Economic Impacts of Houston George Bush Intercontinental Airport

## A.1 Background and Role of the Airport

Houston George Bush Intercontinental Airport (IAH) is Houston's largest airport, and opened in 1969. Located approximately 20 miles away from the Central Business District of the city of Houston, the airport is situated on an 11,000 acre parcel, and contains five runways utilized by scheduled aircraft passenger carriers, cargo carriers, commuter carriers, and general aviation pilots. There is roughly 19 million gallons (a 2 week supply) of fuel on airport grounds, with 1 million gallons in the underground pipeline at any given moment. The airport has five terminals, containing over fifty food and beverage establishments, numerous concession providers, as well as an underground inter-terminal train system that connects the five terminals. IAH also includes a 24-hour mail facility and more than 23,000 parking spaces.

IAH had over 40 million passengers in 2009, and is currently the eighth largest airport in the United States in terms of enplanements, and the sixth busiest airport in the world in terms of total aircraft movements. Domestic passengers accounted for 86 percent of passengers, while international passengers accounted for 14 percent of enplanements. Continental Airlines is the largest carrier at IAH as well as the Houston Airport System and enplaned 20,247,569 total passengers during the 2010 fiscal year. When combined, United Airlines and Continental Airlines handled 86.9 percent of air traffic at IAH.

In 2010, IAH averaged 692 air carrier flights per day. The following 34 scheduled passenger airlines served IAH in 2009:

- ASA
- AeroMexico
- AeroMexico Connect
- Air Canada Jazz
- Air France
- Alaska Airlines
- American Airlines
- American Eagle
- British Airways
- Colgan Air
- Comair
- Compass Airlines
- Continental Airlines
- Continental Express
- Delta Air Lines
- Delta Connection
- Emirates
- ExpressJet
- Frontier Airlines
- KLM Royal Dutch Airlines
- Lufthansa
- Mesa Airlines
- Northwest Airlines
- Pinnacle Airlines
- Qatar Airlines
- Republic Airlines
- Shuttle America
- Singapore Airlines
- Skywest Airlines
- TACA
- United Airlines
- United Express
- US Airways
- US Airways Express
- VivaAerobus

IAH also handles significant air cargo activity. In 2010, 857,764,000 pounds of freight were handled. The airport handles 14 scheduled all-cargo carriers in 2009, listed below:

- ABX Air
- Air France Cargo
- Burlington Air Express
- Cargolux
- Cathay Pacific Cargo
- China Airlines Cargo
- DHL Express
- EVA Airways Cargo
- FedEx Express
- Global Supply Systems Limited
- Korean Air Company
- LAN Cargo
- Martinaire
- Saudi Arabian Airlines Cargo
- Southern Air
- UPS Airlines

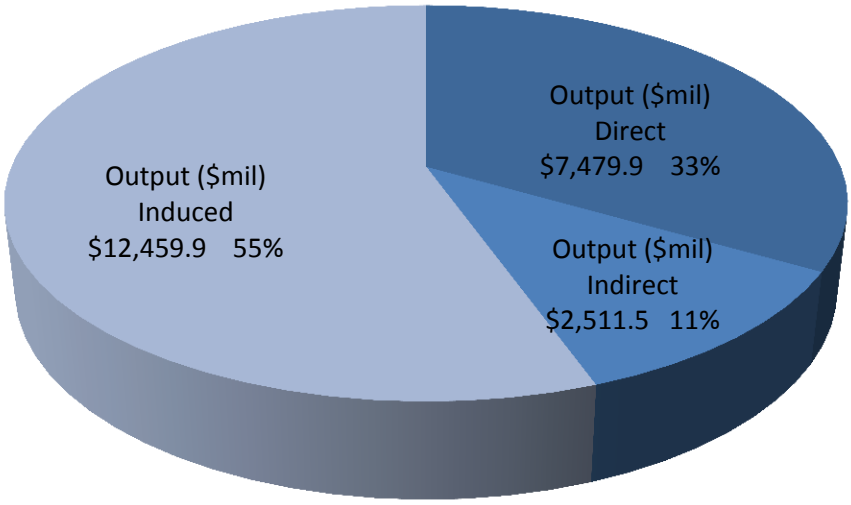
## A.2 Summary of Total Economic Impact

Table A- 1 displays a summary of the economic impact of IAH on the Houston economy. In 2009, IAH supported 172,107 jobs representing $6.833 billion in personal income, and $22.451 billion in output for the Houston regional economy.

**Table A- 1: The Total Economic Impacts of George Bush Intercontinental Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Direct | 35,557 | $2,521.9 | $7,479.9 |
| Indirect | 32,830 | $770.5 | $2,511.5 |
| Induced | 103,720 | $3,541.1 | $12,459.9 |
| **Total** | **172,108** | **$6,833.4** | **$22,451.4** |

**Figure A- 1: The Economic Impact of George Bush Intercontinental Airport**




As discussed in previous sections, there are three different types of impacts. Direct impacts are generated from the use of the airport and related services. Indirect impacts result from the local spending of visitors to the area that arrived via IAH. The induced impacts are the impacts that are the result of the multiplier effect that occurs in the local economy as businesses and individuals spend money that is generated by direct and indirect impacts. The total impact is the impact that is equal to the sum of the direct, indirect, and induced impacts.

Table A- 1 shows that, of the total employment created by IAH in 2009, 35,557 (21 percent) of the jobs were direct impacts, 32,829 (19 percent) of the jobs were indirect impacts, and 103,720 (60 percent) of the jobs were induced impacts.

Local payroll was also significantly impacted by IAH. Of the $6.883 billion in earnings generated by IAH, $2.519 billion (37 percent) was generated by direct economic impacts. $770 million (11 percent) was generated by indirect impacts, and induced impacts constituted $3.541 billion (52 percent) of the total economic payroll impacts.

The total output impacts on the Houston area output in 2009 totaled $22.451 billion. Of this total, direct impacts contributed $7.479 billion (33 percent), while indirect and induced impacts contributed $2.512 billion (11 percent) and $12.459 billion (56 percent), respectively.

## A.3 Direct Impacts

Table A- 2 expands upon Table A- 1, and displays the distribution of IAH's direct impact to different areas within the transportation industry. It shows that business activities of transportation activities at IAH provided the Houston regional economy with $7.479 billion in direct output, $2.521 billion in direct earnings, and 35,557 direct jobs.

**Table A- 2: The Direct Economic Impacts of George Bush Intercontinental Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Airlines | 21,574 | $1,855.4 | $5,146.2 |
| Airport Passenger Services | 848 | $19.7 | $98.8 |
| Passenger Ground Transportation | 4,989 | $254.9 | $401.1 |
| Airport and Aircraft Services | 1,440 | $72.6 | $163.6 |
| Cargo Services | 2,528 | $110.8 | $984.1 |
| Non-Airlines Aircraft Operations | 179 | $11.0 | $89.4 |
| Government | 2,418 | $128.9 | $425.0 |
| Average Annual CIP | 1,582 | $68.6 | $171.6 |
| **Total** | **35,557** | **$2,521.9** | **$7,479.9** |

Airlines comprised the largest proportion in the IAH direct impacts sector, and contributed considerably more than any other category within the transportation industry. Airlines contributed 64 percent of total direct employment, 76 percent of total direct earnings, and 70 percent of total direct output at IAH. Continental Airlines made the largest contribution to the Airlines category, contributing its crew bases as well as its Houston-based headquarters, with over 16,000 employees, and nearly $3.6 billion in direct output.

Passenger ground transportation was the second largest category. It represented 15 percent of total direct employment, 10 percent of total direct earnings, and 6 percent of total direct output at IAH. All taxi and limousine drivers that are part of the Houston Airport System Badging database at IAH were included in the employee counts.

## A.4 Indirect Impacts

Table A- 3 shows the impact of visitors who came to the Houston region via IAH on the local economy. In 2009, approximately 5.08 million visitors came to the Houston region and traveled via IAH. These visitors spent an average of $567 in local purchases in addition to their airfare. The indirect impacts from visitor spending at IAH totaled $2.51 billion in output, representing $348 million in earnings, and 32,830 jobs.

**Table A- 3: The Indirect Economic Effects of George Bush Intercontinental Airport**

| | Bush Intercontinental | | |
|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) |
| Visitor Spending Commercial | 32,189 | $308.0 | $2,459.0 |
| Lodging | 8,853 | $85.8 | $745.7 |
| Food | 15,019 | $84.0 | $675.9 |
| Entertainment | 1,200 | $17.5 | $142.2 |
| Shopping | 1,131 | $19.2 | $176.2 |
| Transportation | 5,559 | $97.8 | $647.6 |
| Other | 427 | $3.7 | $71.4 |
| Visitor Spending General Aviation | 640.9 | $40.2 | $52.4 |
| Lodging | 248.9 | $14.8 | $21.0 |
| Food | 209.6 | $7.2 | $9.4 |
| Entertainment | 8.8 | $0.8 | $1.0 |
| Shopping | 6.7 | $0.7 | $1.0 |
| Transportation | 157.5 | $16.2 | $18.3 |
| Other | 9.4 | $0.5 | $1.6 |
| **Total** | **32,829.9** | **$348.2** | **$2,511.4** |

The food and beverage industry had the highest indirect employment impact, with 47 percent of the total indirect employment at IAH. The lodging category was the second highest, with 28 percent of the total indirect employment at IAH.

The lodging and transportation industries contributed the most to indirect payroll, with 29 percent of the total indirect earnings, each. The transportation industry contributed the most to indirect output at IAH, with 43 percent of the total. This was followed by the lodging industry, with 31 percent of the total indirect output at IAH.

## A.5 Capital Improvement Program Impacts

Bush Intercontinental produces 88 percent of the total capital improvement program output impact over the 2012-2016 period, averaging $381.6 million in total output impact per year. Construction-related earnings average $130.3 million per year over the five year period

and construction-related jobs average 3,280 per year over the five year period. Continental Airlines is planning on investing $100 million over the next five years in construction-related projects. This investment was included in the Bush Intercontinental construction section, which significantly increased the impacts of output, employment and earnings at the airport.

**Table A-4: Average Yearly Impacts from Capital Expenditures at Bush Intercontinental 2012-2016***

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Direct | 1,582.1 | $68.6 | $171.6 |
| Induced | 1,697.6 | $61.7 | $210.0 |
| **Total** | **3,279.7** | **$130.3** | **$381.6** |

*Includes CIP investment from Continental Airlines

# Attachment B: Economic Impacts of Houston William P. Hobby Airport

## B.1 Background and Role of the Airport

Houston Hobby Airport began service in 1927 as a private landing field on a 600-acre plot of land that was formerly known as W.T. Carter Field. The airfield was serviced by Braniff and Eastern Airlines, and was acquired by the City of Houston in 1937 when it was re-named Houston Municipal Airport. The airport grew rapidly in the early 1940's and in 1950; the airport gained its first international route—Pan Am's Houston-Mexico City flight. In 1954 the airport was renamed Houston International Airport, and had its first one-million passenger movement-year. Today, Houston William P. Hobby Airport (HOU) acts as Houston Airport System's second largest airport, and is used solely for domestic operations. It currently has four runways, two of which are strictly used for general aviation. HOU has a 936,721 square foot terminal complex comprised of a main terminal and two concourses.

In 2010, Houston Hobby handled over 9 million domestic passengers. Currently, Southwest Airlines has the largest presence at HOU, handling over 80 percent of the total enplanements at the airport. While air carrier operations totaled 99,677, or 48 percent of the total traffic at HOU, general aviation represented a significant portion of the total traffic 68,003 movements, or 32 percent.

HOU averaged 273 air carrier flights per day in 2010. In 2010; the following 19 air carriers provided passenger service from HOU:

- Atlantic Southeast Airlines
- AirTran Airways
- American Eagle
- Comair, Inc.
- Compass Airlines
- Delta Airlines
- Executive Airlines
- ExpressJet
- Frontier Airlines
- JetBlue Airways
- Kalitta Airlines
- Miami Air International
- Pinnacle Airlines
- Shuttle Airlines
- Skywest Airlines
- Southwest Airlines
- Sun Country Airlines
- Vision Airlines
- Xtra Airways

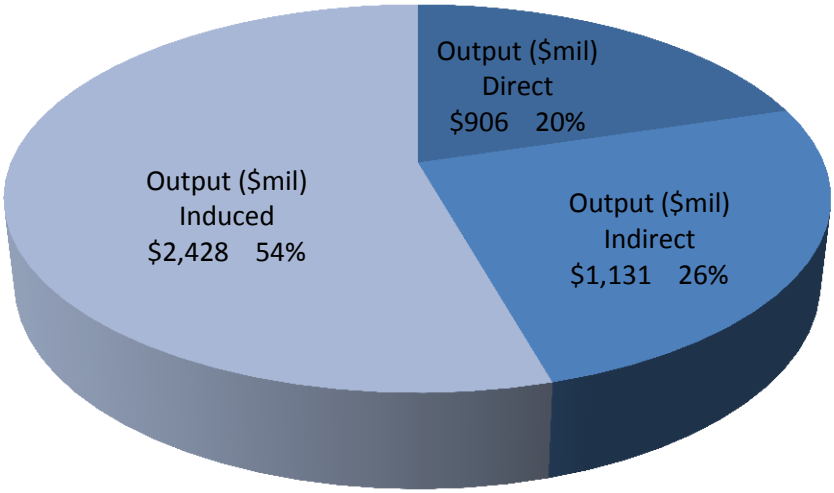
## B.2 Summary of Total Economic Impact

Table B- 1 summarizes the total economic impact of HOU on the Houston regional economy. In 2009, HOU created 52,069 local jobs, generating over $1.7 billion in earnings, and $4.465 billion in output.

**Table B- 1: The Total Economic Impacts of William P. Hobby Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Direct | 7,171.6 | $466.9 | $906.1 |
| Indirect | 14,628.6 | $348.1 | $1,131.3 |
| Induced | 30,269.0 | $894.8 | $2,427.9 |
| **Total** | **52,069.2** | **$1,709.8** | **$4,465.3** |

**Figure B- 1: The Economic Impact of William P. Hobby Airport**




In 2009, 14 percent (7,171) of the jobs were created by direct impacts at HOU, and 28 percent (14,629) of the jobs were derived due to indirect impacts. The remaining 58 percent (30,269) of jobs were the result of the induced impacts.

HOU's direct impacts accounted for 20 percent ($906.1 million) of the total economic impact of the airport. The indirect and induced impacts accounted for 26 percent ($1.13 billion) and 54 percent ($2.43 billion) of the total economic impact of the airport, respectively.

## B.3 Direct Impacts

Table B- 2 shows the direct impact of the transportation-related industries at HOU on the Houston regional economy. These industries created 7,171 jobs, yielding $466.9 million in earnings, and 906.1 million in output.

**Table B- 2: The Direct Economic Impacts of William P. Hobby Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Airlines | 2,924.0 | $251.5 | $453.9 |
| Airport Passenger Services | 451.0 | $13.7 | $32.6 |
| Passenger Ground Transportation | 2,204.2 | $118.7 | $178.3 |
| Airport and Aircraft Services | 308.0 | $19.0 | $54.8 |
| Cargo Services* | n/a | n/a | n/a |
| Non-Airlines Aircraft Operations | 47.0 | $2.9 | $8.2 |
| Government | 1,058.9 | $54.2 | $160.3 |
| Average Annual CIP | 178.5 | $7.0 | $18.1 |
| **Total** | **7,171.6** | **$466.9** | **$906.1** |

*Included with airlines

The largest contributor to the direct economic impacts of HOU is the airline category. Airlines provided 42 percent of the direct employment impact, 55 percent of the direct earnings impact, and 51 percent of the direct output impact. The largest contributor to this category was Southwest Airlines, which, as previously stated, provides the majority of scheduled service and has a large crew base at the airport. Southwest Airlines provide nearly 89 percent of the total output for the airline category.

## B.4 Indirect Impacts

Table B- 3 shows the indirect impacts that arose from the visitor spending of the passengers that traveled through HOU. In 2009, over 2 million passengers visited Houston via HOU. These passengers yielded $1.13 billion in output, generating $348 million in earnings, and 14,630 jobs.

**Table B- 3: The Indirect Economic Effects of Houston William P. Hobby Airport**

| | Houston Hobby | | |
|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) |
| Visitor Spending Commercial | 13,046 | $308.0 | $1,001.8 |
| Lodging | 3,573 | $85.8 | $301.0 |
| Food | 6,016 | $84.0 | $270.7 |
| Entertainment | 479 | $17.5 | $56.8 |
| Shopping | 451 | $19.2 | $70.3 |
| Transportation | 2,355 | $97.8 | $274.3 |
| Other | 172 | $3.7 | $28.7 |
| Visitor Spending General Aviation | 1,583.6 | $40.2 | $129.5 |
| Lodging | 615.0 | $14.8 | $51.8 |
| Food | 517.9 | $7.2 | $23.3 |
| Entertainment | 21.9 | $0.8 | $2.6 |
| Shopping | 16.6 | $0.7 | $2.6 |
| Transportation | 389.1 | $16.2 | $45.3 |
| Other | 23.2 | $0.5 | $3.9 |
| **Total** | **14,629.6** | **$348.2** | **$1,131.3** |

While the food section boasted the largest employment figures of 45 percent (6,534 jobs) of the total indirect jobs, the lodging category provided the highest total indirect output, at 32 percent ($353 million). The transportation category generated the highest earnings, at 32 percent of the total ($109 million).

## B.5 Capital Improvement Program Impacts

Houston Hobby produces 8 percent of the total CIP output impact over the 2012-2016 period, averaging $40.8 million per year. Construction-related earnings average $13.6 million per year over the 2012-2016 period and employment averages 359 per year over the five year period.

**Table B-4: Average Yearly Impacts from Capital Expenditures at Houston Hobby 2012-2016**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Direct | 178.5 | $7.0 | $18.1 |
| Induced | 180.1 | $6.6 | $22.7 |
| **Total** | **358.6** | **$13.6** | **$40.8** |

# Attachment C: Economic Impacts of Ellington Airport

## C.1 Background and Role of the Airport

Ellington Airport (EFD) had the previous role of training military pilots in both World Wars and the Korean War. It was subsequently acquired by the City of Houston in 1984 and now serves as a joint-use civil-military facility, where civil, general aviation users, and military operations, such as the Texas Air National Guard, conduct operations. Today, the military, NASA, air taxi operators, and private pilots use Ellington. EFD is located 15 miles southeast of the central business district of Houston, and has three runways. It is also home to the largest flying club in Texas.

In 2010, EFD handled 110,493 aircraft operations (combined takeoffs and landings). Most of the operations were conducted by general aviation (79,078 operations, or 72 percent), followed by the military (22,823 operations, or 21 percent). Currently, Ellington Airport does not have scheduled air passenger service, and was last served by a scheduled commercial carrier in 2004. Previously, Continental Express served the airport on what was then the shortest commercial scheduled airline route, from Ellington Airport to Houston Intercontinental. Flight times were known to be as short as 6 minutes on the 25-mile journey.

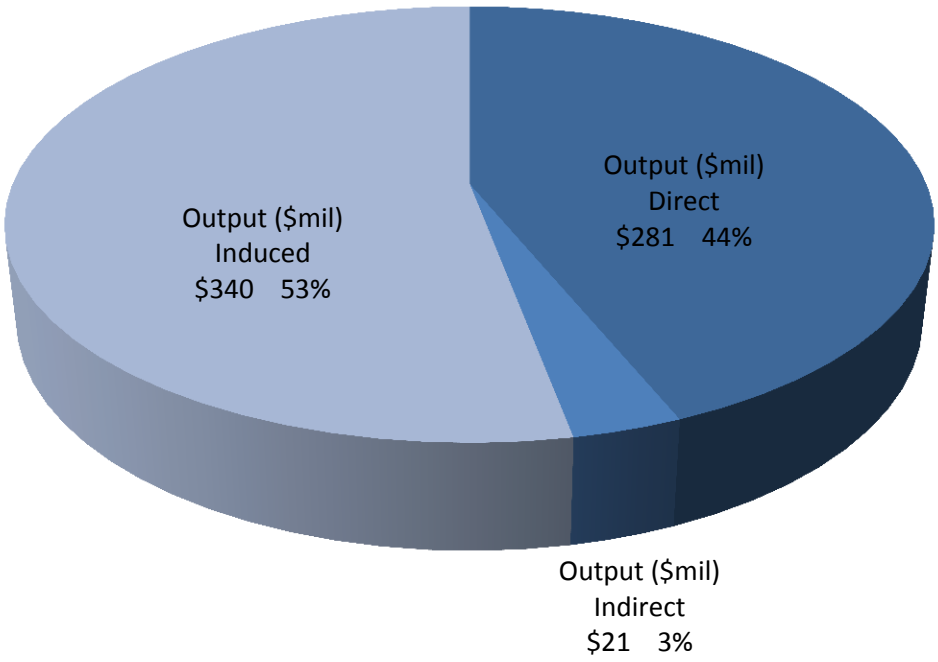
## C.2 Summary of Total Economic Impact

As shown in Table C- 1, EFD provided the Houston regional economy with $641.1 million in output, generating $307.7 million in earnings, and 10,104 jobs.

**Table C- 1: The Total Economic Impacts of Ellington Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Direct | 4,726.5 | $143.9 | $280.7 |
| Indirect | 254.5 | $6.5 | $20.8 |
| Induced | 5,123.2 | $157.3 | $339.6 |
| **Total** | **10,104.1** | **$307.7** | **$641.1** |

**Figure C- 1: The Economic Impact of Ellington Airport**




The two primary contributors to the total economic impact of EFD were the direct impacts and the induced impacts. Indirect impacts are very low at EFD, primarily because EFD's main focus is on general aviation and military traffic. Spending by military reservists for food, clothing and shelter when they visit the region is reflected in the units' budgets and is not counted as visitor spending. Therefore, the only visitors to the region that travel through EFD are general aviation visitors or local residents, and as such, there is no commercial visitor spending impact.

Of the employment impacts created by EFD to the Houston economy, 4,726 jobs (47 percent) came from direct impacts, 255 (3 percent) came from indirect impacts, and 5,132 (51 percent) came from induced impacts.

Direct impacts accounted for $144 million (47 percent) in earnings, while indirect and induced impacts accounted for $6.5 million (2 percent) and $157.3 million (51 percent), respectively.

The distribution of output included $280.7 million (44 percent) from direct impacts, $21 million (3 percent) from indirect impacts, and $339.6 million (53 percent) from induced impacts.

## C.3 Direct Impacts

The direct impacts from the transportation industries at Ellington Airport are listed in Table C- 2. The total direct impact of transportation-related activity at EFD included 4,726 jobs, $143.9 million in earnings, and $280.7 million in output.

**Table C- 2: The Direct Economic Impacts of Ellington Airport**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Airport and Aircraft Services | 61.0 | $2.2 | $12.8 |
| Non-Airlines Aircraft Operations | 62.0 | $2.3 | $13.3 |
| Government | 527.2 | $28.3 | $76.9 |
| Department of Defense | 4,028.0 | $109.1 | $172.7 |
| Average Annual CIP | 48.3 | $2.0 | $5.0 |
| **Total** | **4,726.5** | **$143.9** | **$280.7** |

The large military presence at Ellington Airport represents a substantial (86 percent) portion of the direct employment at the airport. The military and government sectors combined represented 97 percent of all employment on the airport. Additionally, the payroll and output were both dominated by the military and government categories, where the sectors occupied a combined 96 percent and 91 percent of earnings and output, respectively.

## C.4 Indirect Impacts

The approximately 57,000 visitors to Houston arriving via EFD in 2009 (all through general aviation or air taxi flights) generated 255 jobs, representing $6 million in earnings, and $21 million in output. These visitors spent an average of about $368 above the price of airfare during their stay. Table C- 3 shows the breakdown of indirect economic impact due to economic activity at EFD.

**Table C- 3: The Indirect Economic Impacts of Ellington Airport**

| | Ellington Field | | |
|---|---|---|---|
| | Employment | Earnings ($mil) | Output ($mil) |
| Visitor Spending General Aviation | 255.0 | $6.0 | $21.0 |
| Lodging | 99.0 | $2.0 | $8.0 |
| Food | 83.0 | $1.0 | $4.0 |
| Entertainment | 4.0 | $0.1 | $0.4 |
| Shopping | 3.0 | $0.1 | $0.4 |
| Transportation | 4.0 | $0.1 | $1.0 |
| Other | 63.0 | $3.0 | $7.0 |
| **Total** | **255.0** | **$6.0** | **$21.0** |

The Lodging and Transportation categories contributed the most to indirect economic impacts. The Lodging group provided 39 percent of indirect employment, where it contributed the most impact. Lodging also contributed 38 percent of total indirect output, the largest contribution of any section. The transportation group contributed the most to earnings, providing 46 percent of total indirect impact.

## C.5 Capital Improvement Program Impacts

Ellington Airport produces 3 percent of the total CIP output impact over the 2012-2016 period, averaging $11.3 million per year. Earnings from construction-related projects average $3.8 million per year and there are is average of 98 jobs created per year over the five year period.

**Table C-4: Average Yearly Impacts from Capital Expenditures at Ellington Airport 2012-2016**

| | Employment | Earnings ($mil) | Output ($mil) |
|---|---|---|---|
| Direct | 48.3 | $2.0 | $5.0 |
| Induced | 50.1 | $1.8 | $6.3 |
| **Total** | **98.3** | **$3.8** | **$11.3** |

# Report on Trade Facilitation Study

**to Accompany the**

**Houston Airport System Economic Impact Study**

**by GRA**

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June 15, 2011

## Executive Summary

This paper reports on our research to ascertain the extent to which air travel is an essential component of any economic environment, by estimating the extent to which international air travel is a precursor to international trade. Specifically, we estimate a statistical relationship which relates how international air travel passengers result in increased international trade 1, 3, and 12 months later. The objective of our empirical exploration is to affirm that air traffic is important to forming business relationships, which therefore results in increased trade. We view our demonstration with international air travel and trade to be just a small example of the importance of air travel infrastructure and business activity.

Our statistical approach studies international trade and associated air travel with 34 countries. While there are some data limitations, we nonetheless capture over 60% of Houston's international air travel, and over 52% of its international trade. Our statistical procedure compares how variation in the number of air travellers is correlated with variation in the value of international trade within 12 months of the increase in air travel. Our work demonstrates that:

- The average international air passenger from one of the 34 countries in our data results in up to $1,700 in exports out of Houston within the subsequent 12 months.

- The average international air passenger from one of the 34 countries in our data results in, at a minimum, over $800 in exports out of Houston within the subsequent month.

These results suggest that the relationship between air travel and economic trade is important. Despite that our estimates average air passengers of all types, and average trading partner countries of various importance, all of the results are statistically certain to be positive, and are economically important. Although we use a different methodology, the results we find here are similar to those found in the academic literature. For example, a recent study by Poole (2011) found $4,300 in trade to be associated with each business traveler.

We were unable to find data to determine how much of the exports from Houston are produced in the Houston region. A review of the export sectors, however, reveals significant strength in industries which are important to the local Houston economy. Until such a study can be conducted, therefor, the resulting economic impact estimate use only half of the estimated increase in trade as representing an increase in local economic production. We demonstrate the economic impact, however, is nonetheless significant even if only 35% of exports are produced in the local economy, and also show how extensive the impact is if 65% of exports are produced in Houston.

## Introduction

It is well known that the transportation infrastructure of any city or region is essential to business activity between that city and the rest of the world. This is at least as true today as at any time in the past, and is certainly true for modern airports. One of the important aspects of a study of the economic impact of the Houston airport is to statistically illustrate how the airport interacts with the modern economy and economic trade. To capture this process, we have

conducted a statistical analysis of how air travel relates to international exports out of Houston. This is a small part of the total process of how transportation infrastructure relates to economic activity, as of course exports out of Houston to the rest of the U.S. is a large part of the Houston economy. We study international trade because the data is readily available. The point is that our findings for international trade are the "tip of the iceberg" for business activity overall, but nonetheless illustrates the importance to the local economy of an excellent transportation infrastructure.

International air travel is a key input into facilitating international trade. The availability of convenient and cost effective air travel is central to developing the type of personal relationships that make doing business in a foreign environment easier, and as a result more productive. In a recent working paper exploring this relationship, Poole (2011) finds that business travelers to the U.S. that are neither residents nor citizens of the U.S. positively impact bilateral trade.[17] More specifically, Poole finds that for a 10 percent increase in travel to the U.S. by these non-residents and non-citizens, new exports originating in the U.S. increase by 0.9 percent and existing exports from the U.S. increase by 1.3 percent. For more illustrative purposes, this is equivalent to the introduction of 18 new export types per country per quarter, and $4,300 in additional sales in existing exports for each traveler. The findings in Prof. Poole's paper therefore suggest that facilitation of air travel between countries may indeed help reduce the informal barriers to international trade and as a result, may positively impact international trade. The study we report upon here demonstrates a similar level of economic importance for the Houston region, using a similar but not identical methodology. Specifically, we compare the number of international air travelers between specific countries and Houston, and statistically estimate how much exports out of Houston vary for up to one year after the number of international air passengers varies. Our data does not identify the purpose of travel, but still illustrates the importance of air traffic of all types. This analysis is conducted using monthly data from 2002 through 2009 for the 34 largest air travel partner countries with Houston.

## Data

We initiate our investigation using the period since the 9/11 attacks, so as not to confound other influences on international trade and air passengers. The data for exports come from the Foreign Trade Division of the U.S. Census Bureau. Using the Bureau's USA Trade Online service, we use monthly data from January 2002 through December 2009 on the dollar value of exports leaving Houston. The source of the data for the number of international passengers flying from Houston is the T100 International Market Data collected by the Bureau of Transportation Statistics. The T100 data reported at the city level is recorded monthly, we use the data from January 2002 until December 2009 to match our export data. Since the export data is reported at the country level, it was necessary to aggregate the totals of air passengers for all cities in each country.

[17] Poole, J. 2011. "Business Travel as an Input to International Trade," working paper, University of California, Santa Cruz. This paper is in the process of being accepted at the *Canadian Journal of Economics*, a highly respected academic outlet.

One problem with the export data for the purpose of doing economic impact analysis is that while the data accurately portrays the dollar value of exports leaving Houston, it does not list the value of the exports produced in the Houston metropolitan region. Table 1 lists the sectors and the relative values of exports from Houston. The largest sectors are machinery manufacturing, which is predominately oilfield equipment, and chemicals. Both of the industries have extensive concentrations in the Houston area, and have transportation costs that would suggest a location close to transshipment points. Thus for the economic impact analysis we assume 50% of exports are produced in the Houston area, but this figure is much more likely to be an under-estimate rather than an over-estimate. We nonetheless present economic impact estimates for a variety of potential production shares in Houston.

The number of countries receiving exports is considerably larger than the number of countries to which passengers fly from Houston. Additionally, some countries had very few air passengers from 2002 to 2009. For the data to be comparable across countries, we include in our analysis only countries with an average of at least 100 international passengers to Houston per month. This threshold requirement reduced the dataset to 36 countries. Additionally, we dropped Taiwan because data for half the years were missing. Finally, we also dropped Mexico because of its special relationship with Houston. Trade and travel by land between Houston and

**Table D- 1: Value of Exports from Houston**

| | | Dollar Value Average from 2002-2009 | Share of Exports from Houston |
|---|---|---|---|
| 1 | Crop and Animal Production | 1,025,730,051 | 1.85% |
| 2 | Forestry, fishing, and related activities | 2,598,418 | 0.00% |
| 3 | Oil and gas extraction | | |
| 4 | Mining, except oil and gas | 164,892,354 | 0.30% |
| 5 | Support activities for mining | | |
| 6 | Utilities | | |
| 7 | Construction | | |
| 8 | Wood product manufacturing | 53,057,788 | 0.10% |
| 9 | Nonmetallic mineral product manufacturing | 10,162,869,253 | 18.34% |
| 10 | Primary metal manufacturing | 268,921,618 | 0.49% |
| 11 | Fabricated metal product manufacturing | 1,731,206,256 | 3.12% |
| 12 | Machinery manufacturing | 14,503,144,520 | 26.17% |
| 13 | Computer and electronic product manufacturing | | |
| 14 | Electrical equipment and appliance manufacturing | | |
| 15 | Motor vehicle, body, trailer, and parts manufacturing | 1,723,169,466 | 3.11% |
| 16 | Other transportation equipment manufacturing | 1,070,421,249 | 1.93% |
| 17 | Furniture and related product manufacturing | | |
| 18 | Miscellaneous manufacturing | 2,623,338,399 | 4.73% |
| 19 | Food, beverage, and tobacco product manufacturing | 2,798,289,581 | 5.05% |
| 20 | Textile and textile product mills | 718,831,098 | 1.30% |
| 21 | Apparel, leather, and allied product manufacturing | 101,048,833 | 0.18% |
| 22 | Paper manufacturing | 233,899,350 | 0.42% |

| | | | |
|---|---|---|---|
| 23 | Printing and related support activities | | |
| 24 | Petroleum and coal products manufacturing | | |
| 25 | Chemical manufacturing | 12,441,519,012 | 22.45% |
| 26 | Plastics and rubber products manufacturing | 4,922,045,006 | 8.88% |
| 27 | Wholesale trade | | |
| 28 | Retail trade | 779,677,885 | 1.41% |
| 29 | Air transportation | | |
| 30 | Rail transportation | | |
| 31 | Water transportation | | |
| 32 | Truck transportation | | |
| 33 | Transit and ground passenger transportation | | |
| 34 | Pipeline transportation | | |
| 35 | Other transportation and support activities | | |
| 36 | Warehousing and storage | | |
| 37 | Publishing industries, except Internet | 43,770,273 | 0.08% |
| 38 | Motion picture and sound recording industries | 15,442,034 | 0.03% |
| 39 | Broadcasting, except Internet | | |
| 40 | Telecommunications | | |
| 41 | Internet and other information services | | |
| 42 | Federal Reserve banks, credit intermediation and related services | | |
| 43 | Securities, commodity contract, investments | | |
| 44 | Insurance carriers and related activities | | |
| 45 | Funds, trusts, and other financial vehicles | | |
| 46 | Real estate | | |
| 47 | Rental and leasing services and lessors of intangible assets | | |
| 48 | Professional, scientific, and technical services | | |
| 49 | Management of companies and enterprises | | |
| 50 | Administrative and support services | | |
| 51 | Waste management and remediation services | 41,748,569 | 0.08% |
| 52 | Educational services | | |
| 53 | Ambulatory health care services | | |
| 54 | Hospitals | | |
| 55 | Nursing and residential care facilities | | |
| 56 | Social assistance | | |
| 57 | Performing arts, spectator sports, museums, zoos, and parks | | |
| 58 | Amusements, gambling, and recreation | | |
| 59 | Accommodation | | |
| 60 | Food services and drinking places | | |
| 61 | Other services | | |
| 62 | Households | | |
| | **Houston Total** | **55,425,621,011** | **100.00%** |

Note: Blanks indicate essentially zero. Data include trade from both the airport, and the Port of Houston

Source: US Census Bureau

Mexico is relatively easy, and in fact is quite robust. The objective of our statistical analysis is to capture how extra air passengers to any of the countries in the data would stimulate international trade between that country and Houston. Thus, the final country total included in the analysis is 34 countries. The eight complete years of trade and passenger data thus results in 96 observations per country, and 3,230 total observations. The observations in our analysis thus covers about 60% of total international air travel, and about 52% of total international trade originating in Houston.

## Analysis Structure

In conducting our study, we are required to make a series of assumptions about how to organize the data. In doing so, we have endeavored to use the most conservative assumptions, with the idea that our determination of the trade facilitation impact of air travel is more likely to be an underestimate than the reverse. Our statistical analysis has as its objective to estimate how much on average exports out of Houston rise for each additional international air passenger. This type of analysis is called regression analysis, and is a well-established and oft used statistical procedure in economics and many other disciplines.

The statistical analysis uses as its basis whether, and to what extent, air travel stimulates international trade. International trade, however, of course depends on many other components. Our statistical model is a simplification of the entire relationship, but one in which the influence of air travel is isolated from other possible factors. The basic relationship can be seen in the following equation:

(1) $$\text{Int'l Exports}_t = f(\text{ Air Travel}_{t-1}, \text{Month, Year, Country*Month })$$

The variable Int'l Exports represents exports out of Houston during a specific month and year to the specific country. Air Travel represents the number of passengers originating in the same country, but at a prior time as indicated by t - 1. This is called a lagged relationship, and it is one method by which the direction of change is modeled. As detailed below, we experiment with a variety of lag lengths, including one, three, and twelve months. That is, if international air passengers occur in a prior time, we can ascertain that passengers caused trade, rather than that trade resulted in air travel (which might be expected to happen as well, but which would affect future air travel, not past).[18] We experimented with a series of other variables, such as exchange rates and country income. As there are many other factors that are also important, however, we found the best method to isolate the impact of air passengers from all other possible causes is to use what are called fixed effects. Fixed effects allow each month to have its own value (for example air travel on specific holidays may increase due to leisure travel). Further, we allow each year to have its own influence. The year effect might capture changes in income, but also weather, population movement, the economic cycle of particular industries, and a host of other possibilities. Finally, in some specifications we also allow each country to have its own monthly

[18] It would also be possible to build a more complete model, by specifying the determinants of international air travel as well. Such a modeling strategy is beyond the scope of the current study, and would also benefit from a more extensive data source.

effects, so that growth in the internal changes in the relationship between a country and Houston can vary for each country by month. Thus the model does not determine all of the causes of exports, rather it allows each country that trades with Houston to have its own effects, and its own time trend, so that all of the possible influences have their own effect. By this fixed effects process, then, the incremental impact of air travel on exports can be statistically isolated from all other possible effects.

We experiment with a variety of lags shown in the relationship in equation (1) between air passengers and international trade. All of the specifications show that lagged passengers are positively associated with increased international trade out of Houston, irrespective of whether we use one month, three month, or twelve month lags. That is, our regression procedure will answer the question, "if one more international air passenger came to Houston, on average how much more would exports from Houston to that same country rise (1, 3, or 12) months later." We also experiment with whether or not to allow the statistical effect of each month to vary by country.. Adding additional factors into the analysis allow the data to show whether variation in international trade might be the artifact of some other process specific to each country rather than air travel. In fact, however, adding these more finely differentiated potential factors into the estimated equation did not discern another process, but instead solidified the statistical conclusion that air travel is linked with international trade.

## Results of Whether Air Travel Stimulates Foreign Trade Out of Houston

Despite the conservative process we use to estimate the contribution of air travel to international trade, our statistical analysis reveals that international air travel has a substantial impact on the Houston economy. In particular, we find that air travel has a statistically significant, and quantitatively important, impact on exports out of Houston. Table 2 presents a range of statistical estimates for this process. The smallest effect we find, using a one month lag without the country-specific monthly variable, is $816.45 per passenger. On the other hand, using the longer lag of twelve months along with the country specific monthly variable produces the largest estimate of $1,712.41 in exports for each international air passenger. The statistical estimates are relatively precise, as we find the probability is less than 1% that the true estimate is zero. Further, even the range shown by the variety of the specifications is relatively narrow, between $816 and $1,712. All of these econometric estimates point to the fact that international air travel leads to increases in international trade out of Houston. Further, these statistical results boost the identical point made in the work by Prof. Poole cited earlier, although we use a different research process to come to an identical conclusion.

The statistical estimate of the effect of international air travel on resulting international exports is very much an average. It averages passengers from a variety of countries for all of the possible purposes that cause people to travel. People travelling directly for business will undoubtedly have a much larger impact (such as the $4,300 estimate from Poole (2011)), while people travelling to visit friends and relatives will have an impact only as large as their entertainment expenses.[19] We statistically explore whether we could discern a country-specific

[19] Unfortunately, we do not have current data on the purpose of international air travel.

effect from this process. When we segment the data to look only at OECD countries, which are the high income developed countries, we found statistical estimates of trade impacts to be about half the size. On the other hand, the estimates for less well developed economies suffer from the small number of observations as well as the greater heterogeneity between countries. These estimates tend to be larger, therefore, but with much less statistical precision. A similar pattern was observed when we segmented the data by geographic area, which is also correlated with average income. We thus believe the overall average is the most reliable indicator of the true underlying relationship, but caution should be exercised in applying these estimates to travel from specific countries.

**Table D- 2: Estimated Impact of Air Travel on Exports out of Houston**

| Air Passengers Lagged by: | Estimated Impact on Exports to Houston (No Country*Month) | Estimated Impact on Exports to Houston (Country*Month) | Observations |
|---|---|---|---|
| One Month | 816.45***<br>-237.85 | 1,270.66***<br>-324.27 | 3,230 |
| Three Months | 980.40***<br>-241.29 | 1,553.49***<br>-331.61 | 3,162 |
| Twelve Months | 1,221.74***<br>-267.29 | 1,712.41***<br>-376.34 | 2,856 |

Note: All regressions allow fixed effects for month of the year, for year, and for country The number of observations drops going from 1 to 12 months because the lagged term causes the first observations to be dropped (where there is no lagged data). This country trend allows the fixed effect for each month to vary by country. Standard errors are in parentheses. *** Indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.

## Summary and Conclusion

Our study of how international air travel interacts with international exports out of Houston has presented substantial and statistically strong evidence that air travel leads to larger exports. This is not at all surprising given that business facilitation is one of the original purposes of developing transportation infrastructure, and is also consistent with other recent research by Poole (2011). Our statistical approach is somewhat more aggregative than that by Poole, as we combine travel and trade from all countries with enough data to be meaningful, and for all trip purposes. Nonetheless, our results are very much in line with that of the prior research. We find that each international air passenger is associated on average with additional exports in a range of $816 one month later, to $1,712 one year later. These estimates are statistically reliable, and hold up across a large variety of econometric alternatives.

It is also important to note that our statistical estimates of how air travel links to local production are incomplete. Specifically, our analysis uses the international environment because of the availability of data. While there is no data showing how much business is transacted between states, both air travel and trade would be expected to be at least an order of magnitude

larger. Even if the stimulative impact of air travel is much less per average passenger, clearly air travel is an integral part of economic activity. This report has documented the importance of air passenger travel in the international sphere, which powerfully suggests that air travel would be expected to be a key component to the development of business and trade in the local and national sphere.

The economic impacts from exports were calculated using the same methodology as in the Houston Airport System Economic Impact Study above. Using total international passengers obtained from December 2010 T-100 data (8,507,878) and the average increase in trade per passenger as outlined in table 2 of the Trade Facilitation Study ($1,221,70), we calculated the total trade increase to the Houston region ($10,394,074,552.60). We then took 50 percent of this figure as indicated in the assumption in the Trade Facilitation Study and applied to the percentages in Table D-1 to arrive at $5,197,037,276.30. In the tables below we report economic impacts for the relevant sectors for average international passengers and country-specific international passengers. Table D-3 reports the economic impacts using the average increase in trade per passenger ($1,221.70); Table D-4 reports the economic impacts using the country-specific increase in trade per passenger.

**Table D- 3: Impacts from Trade for Average International Passengers**

| Relevant Sectors | Total Impacts | | |
|---|---|---|---|
| | Employment | Earnings | Output |
| Crop and Animal Production | 1,800 | $ 40,741,245.0 | $ 183,624,138.0 |
| Forestry, fishing, and related activities | 5 | $ 123,283.4 | $ 444,210.2 |
| Mining, except oil and gas | 166 | $ 8,559,371.2 | $ 31,301,385.6 |
| Wood product manufacturing | 59 | $ 2,218,359.2 | $ 9,330,640.8 |
| Nonmetallic mineral product manufacturing | 11,585 | $ 509,818,257.7 | $ 2,025,455,526.4 |
| Primary metal manufacturing | 257 | $ 12,131,271.9 | $ 51,919,120.4 |
| Fabricated metal product manufacturing | 2,178 | $ 94,799,691.5 | $ 344,785,179.3 |
| Machinery manufacturing | 16,659 | $ 775,143,829.7 | $ 2,895,502,179.4 |
| Motor vehicle, body, trailer, and parts manufacturing | 1,101 | $ 49,813,468.1 | $ 264,303,831.2 |
| Other transportation equipment manufacturing | 1,297 | $ 62,891,271.7 | $ 221,384,101.3 |
| Miscellaneous manufacturing | 3,383 | $ 165,962,623.1 | $ 537,097,061.8 |
| Food, beverage, and tobacco product manufacturing | 2,528 | $ 101,306,595.6 | $ 499,947,130.9 |
| Textile and textile product mills | 885 | $ 28,996,296.2 | $ 118,135,305.3 |
| Apparel, leather, and allied product manufacturing | 119 | $ 3,662,065.1 | $ 16,168,988.7 |
| Paper manufacturing | 211 | $ 9,568,844.4 | $ 39,516,717.5 |
| Chemical manufacturing | 11,437 | $ 603,010,957.3 | $ 2,966,174,617.8 |
| Plastics and rubber products manufacturing | 5,466 | $ 235,836,893.0 | $ 1,059,696,849.2 |
| Retail trade | 1,610 | $ 45,399,605.6 | $ 142,215,543.9 |
| Publishing industries, except Internet | 54 | $ 2,508,874.4 | $ 8,224,330.6 |
| Motion picture and sound recording industries | 24 | $ 685,163.9 | $ 2,726,031.5 |
| Waste management and remediation services | 48 | $ 2,068,472.1 | $ 7,733,282.7 |
| **Houston Total** | **60,871** | **$ 2,755,246,439.9** | **$ 11,425,686,172.3** |

## Table D- 4: Impacts from Trade for Country Specific International Passengers

| Relevant Sectors | Total Impacts | | |
|---|---|---|---|
| | Employment | Earnings | Output |
| Crop and Animal Production | 2,523 | $ 57,105,439.0 | $ 257,378,906.0 |
| Forestry, fishing, and related activities | 7 | $ 172,801.7 | $ 622,632.4 |
| Mining, except oil and gas | 233 | $ 11,997,342.2 | $ 43,873,950.8 |
| Wood product manufacturing | 83 | $ 3,109,389.0 | $ 13,078,401.1 |
| Nonmetallic mineral product manufacturing | 16,238 | $ 714,592,684.5 | $ 2,839,003,272.5 |
| Primary metal manufacturing | 361 | $ 17,003,938.2 | $ 72,773,038.4 |
| Fabricated metal product manufacturing | 3,052 | $ 132,877,089.0 | $ 483,272,152.6 |
| Machinery manufacturing | 23,350 | $ 1,086,489,355.4 | $ 4,058,514,272.8 |
| Motor vehicle, body, trailer, and parts manufacturing | 1,543 | $ 69,821,626.4 | $ 370,464,535.9 |
| Other transportation equipment manufacturing | 1,818 | $ 88,152,281.7 | $ 310,305,597.9 |
| Miscellaneous manufacturing | 4,742 | $ 232,623,439.0 | $ 752,828,337.2 |
| Food, beverage, and tobacco product manufacturing | 3,544 | $ 141,997,566.8 | $ 700,756,704.9 |
| Textile and textile product mills | 1,240 | $ 40,642,995.5 | $ 165,585,723.2 |
| Apparel, leather, and allied product manufacturing | 166 | $ 5,132,976.1 | $ 22,663,450.9 |
| Paper manufacturing | 296 | $ 13,412,281.9 | $ 55,389,066.2 |
| Chemical manufacturing | 16,031 | $ 845,217,314.7 | $ 4,157,573,117.2 |
| Plastics and rubber products manufacturing | 7,662 | $ 330,563,521.2 | $ 1,485,336,401.4 |
| Retail trade | 2,256 | $ 63,634,884.7 | $ 199,338,069.6 |
| Publishing industries, except Internet | 76 | $ 3,516,592.9 | $ 11,527,728.6 |
| Motion picture and sound recording industries | 33 | $ 960,368.0 | $ 3,820,973.8 |
| Waste management and remediation services | 67 | $ 2,899,297.9 | $ 10,839,445.6 |
| **Houston Total** | **85,320** | **$ 3,861,923,185.9** | **$ 16,014,945,779.1** |