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# VALUE CAPTURE and LAND POLICIES

Edited by Gregory K. Ingram and Yu-Hung Hong

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# *Airport Improvement Fees, Benefit Spillovers, and Land Value Capture Mechanisms*

Anming Zhang

According to recent research, on average 15 percent of a consumer's total airfare is used for infrastructure-related costs (Karlsson, Odoni, and Gaudet 2008). To this end, many airports around the world are collecting "airport improvement fees" from passengers to pay for airport infrastructure development and/or debt repayment. Some airports collect these fees at the time of departure, others at the time of ticketing (as is reflected in the "additional charges" portion of airline ticket prices). In the United States, President Barack Obama's proposed fiscal year 2012 budget calls for a $1.1 billion reduction in grants to large and medium-size airports, but would allow airports to increase passenger facility charges for non-federal passengers.[1] Despite suggestions by the Obama administration that passenger facility charges could be increased to offset cuts in federal monies, both the Senate and the House versions of the Federal Aviation Administration (FAA) reauthorization bill maintain the current cap at $4.50 per passenger per flight segment (Darson 2011).

I would like to thank Sam Choo, Yuming Fu, Mike Tretheway, Gavin Yang, and especially Robin Lindsey for very helpful discussions. I would also like to thank Jeffrey Cohen, Gregory Ingram, Yu-Hung Hong, and participants in the Lincoln Institute of Land Policy's 6th Annual Land Policy Conference: Prospects for Land Value Capture for helpful comments.

1. The proposed budget allocates $128 billion for the Department of Transportation, including $1.24 billion for the Federal Aviation Administration's NextGen air traffic control system. It also includes $8 billion for high-speed rail development, representing the first installment of a six-year, $53 billion plan.

How else might airports pay for infrastructure improvements? Airports create local benefit spillovers, such as urban economic development and increases in employment and tourism. Should these positive externalities be internalized? If an airport is a public good, should people other than passengers pay for infrastructure development as well? Do any land value capture mechanisms exist through which such internalization could be realized? This chapter examines these issues.

## *Airport Improvement Fees*

Karlsson, Odoni, and Gaudet (2008) investigated the following question: in the United States, how many cents out of every dollar spent by passengers on commercial air transportation eventually go toward paying for the capital, operational, and security costs of airport infrastructure? They found that when fully accounted for and when treated as a single cost category, infrastructure-related costs account for about 15 percent of the total costs of air transport, constituting the third-highest cost category (after labor and fuel).

In the United States, a major component of the infrastructure-related costs is passenger taxes on domestic airline tickets. As of 2011, there were four such taxes—the ticket tax, passenger facility charge, segment tax, and security tax—introduced in 1941, 1992, 1997, and 2002, respectively (see table 13.1). Taking the four taxes as a whole, Karlsson et al. (2007) estimated that the effective tax

**Table 13.1**
U.S. Passenger Taxes on Domestic Air Travel

| Tax | Rate | Remarks |
|---|---|---|
| Ticket tax | 7.5% of base fare | Introduced in 1941 at 5%; 10% in early 1990s<br>Gradually reduced to 7.5% with introduction of segment tax |
| Passenger facility charge | \$0, \$1, \$2, \$3, \$4, or \$4.50/takeoff[a] | Introduced in 1992 (up to \$3)<br>Airports choose rate in application<br>Cap increased to \$4.50 in 2000 |
| Segment tax | \$3.60/takeoff | Introduced in 1997 at \$1<br>Gradually increased to \$3.60<br>Not applicable to passengers to and from Hawaii, Alaska, or remote airports |
| Security fee | \$2.50/takeoff | Introduced in 2002 at \$2.50 |

[a]Takeoff taxes are imposed only on the first two takeoffs each way.
Source: Adapted from Huang and Kanafani (2010).

rate—defined as the ratio of passenger taxes to airfares—increased from 10.9 percent in 1993 to approximately 16 percent in 2004.[2]

Of particular interest in this chapter is the passenger facility charge (PFC), the term used for the airport improvement fee in the United States. The PFC is the main source of each airport's nonoperating revenues, which, together with the operating revenues, constitute an airport's total income.[3] The operating revenues include both nonaeronautical revenues, such as concessions, car rental, and car parking, and aeronautical revenues. Although airports differ somewhat, most derive their aeronautical revenues from the following charges: landing fees, terminal rental fees (e.g., rents paid by airlines and gate leases), aircraft parking, cargo and hangar rentals, fuel sales, and others, with the first two fees accounting for the lion's share. The operating and nonoperating revenues make up, respectively, 72 percent and 28 percent of total airport revenues (Odoni 2009).

Since 1992 U.S. airports have collected a PFC of up to $4.50 for each departing passenger, subject to FAA approval. Airports use the proceeds from this fee to fund FAA-approved projects that enhance airport infrastructure (i.e., airside, landside, noise, and access projects)[4] and to repay debts related to infrastructure development (see table 13.2). As of 31 March 2011, 382 locations were approved for the collection of PFCs—including 98 of the top 100 airports in the United States—and a total of 1,880 applications had been approved or partially approved. Table 13.3 shows a steady increase over the years in PFCs collected by U.S. airports up to 2007. The total collected from 1992 to 2010 was $32.7 billion. Table 13.4 shows PFC amounts collected at major U.S. airports in 2009, as well as the first PFC collection date for each airport.

In Canada most airports have, since the early 1990s, moved away from direct federal control and are now under the direction of autonomous, not-for-profit airport authorities. One consequence of the move to the not-for-profit format was the introduction of airport improvement fees (AIFs). Canada's airport authorities cannot raise equity via share sales, thus limiting their ability to undertake major capital projects (Tretheway 2001). More specifically, since the Canadian airport authorities were all established without any initial equity capital, needed investments in infrastructure were delayed due to a lack of funding. (Lenders are not comfortable extending 100 percent debt financing to a major organization, especially a new one.) To obtain financing for a major project, the airports first need to establish a base of equity capital. The only source of equity financing is retained earnings, which can only be built from profitable operations. The

2. The equivalent intra–European Union tax rate was 18 percent in 2004 (Karlsson et al. 2007). See also Karlsson, Odoni, and Yamanaka (2004).

3. The other sources of airports' nonoperating revenues are direct grants from the federal government, interest on deposits, and miscellaneous items (Odoni 2009).

4. Airside infrastructure refers mainly to runways and apron (for aircraft parking) whereas landside infrastructure refers mainly to terminals.

**Table 13.2**
Approved U.S. Passenger Facility Charges (PFCs), by Category (with interest as a lump sum), 31 March 2011

| Category (% of Total PFCs) | Project Type | Amount (million $) | Percentage of Category |
|---|---|---|---|
| Airside (18) | Runways | 5,997 | 43.8 |
| | Taxiways | 2,288 | 16.7 |
| | Aprons | 1,576 | 11.5 |
| | Land | 512 | 3.7 |
| | Equipment | 1,220 | 8.9 |
| | Planning | 609 | 4.4 |
| | Lighting | 285 | 2.1 |
| | Other | 1,195 | 8.7 |
| | Subtotal | 13,682 | 100.0 |
| Landside (36) | Terminal | 24,622 | 87.9 |
| | Land | 1,224 | 4.4 |
| | Security | 2,162 | 7.7 |
| | Subtotal | 28,008 | 100.0 |
| Noise (4) | Land | 491 | 15.5 |
| | Multiphase | 1,327 | 41.7 |
| | Soundproofing | 1,312 | 41.3 |
| | Monitoring | 19 | 0.6 |
| | Planning | 15 | 0.5 |
| | Other | 16 | 0.5 |
| | Subtotal | 3,180 | 100.0 |
| Access (7) | Roads | 2,162 | 39.7 |
| | Rail | 3,200 | 58.8 |
| | Land | 12 | 0.2 |
| | Planning | 71 | 1.3 |
| | Subtotal | 5,446 | 100.0 |
| Interest (35) | | 26,945 | 100.0 |
| | Total | 77,262 | |

Note: Totals may not add up to 100% because of rounding.
Source: U.S. Federal Aviation Administration, PFC Branch.

**Table 13.3**
Actual Collection of U.S. Passenger Facility Charges, 1992–2010

| Calendar Year | Amount (million $) |
|---|---|
| 1992 | 85 |
| 1993 | 485 |
| 1994 | 849 |
| 1995 | 1,046 |
| 1996 | 1,114 |
| 1997 | 1,223 |
| 1998 | 1,449 |
| 1999 | 1,515 |
| 2000 | 1,557 |
| 2001 | 1,586 |
| 2002 | 1,857 |
| 2003 | 2,015 |
| 2004 | 2,211 |
| 2005 | 2,448 |
| 2006 | 2,587 |
| 2007 | 2,788 |
| 2008 | 2,660 |
| 2009 | 2,522 |
| 2010 | 2,715 |

Source: U.S. Federal Aviation Administration, PFC Branch.

authorities are not-for-profit organizations, however, suggesting that assembling retained earnings is, by definition, impossible.[5] Furthermore, long-established pricing policies prevent the authorities from raising aeronautical charges (fees assessed on airlines for the use of runways and terminal gate and ticketing facilities) prior to investments being put into productive use.

The airport authorities have dealt with this problem by implementing charges directly on passengers. The Vancouver Airport Authority was the first to do so, in 1993. It called its charge an airport improvement fee. Passengers departing the airport pay C$5 for travel within the provinces of British Columbia and Yukon Territory; they pay C$15 for travel to other destinations. Vancouver's AIFs were

5. In Canada the airports' not-for-profit status does not prevent them from earning a profit. Instead, it merely implies that any net earnings must be reinvested in airport infrastructure.

**Table 13.4**
Passenger Facility Charges (PFCs) at Major U.S. Airports, 2009

| Airport Code | Airport Name | City, State | Amount (thousand $) | First PFC Date; Amount |
|---|---|---|---|---|
| ABQ | Albuquerque Int'l Sunport | Albuquerque, NM | 7,380 | 7/1/96; $3 |
| ALB | Albany Int'l Airport | Albany, NY | 4,078 | 3/1/94; $3 |
| ATL | Hartsfield–Jackson Atlanta Int'l Airport | Atlanta, GA | 166,911 | 5/1/97; $3 |
| AUS | Austin–Bergstrom Airport | Austin, TX | 15,728 | 7/1/94; $3 |
| BNA | Nashville Int'l Airport | Nashville, TN | 11,480 | 1/1/93; $3 |
| BOS | Boston Logan Int'l Airport | Boston, MA | 50,102 | 11/1/93; $3 |
| BWI | Baltimore Washington Int'l Airport | Baltimore, MD | 40,824 | 10/1/92; $3 |
| CLE | Cleveland Hopkins Int'l Airport | Cleveland, OH | 19,378 | 11/1/92; $3 |
| CLT | Charlotte Douglas Int'l Airport | Charlotte, NC | 46,093 | 11/1/04; $3 |
| CVG | Cincinnati/Northern Kentucky Int'l Airport | Cincinnati, OH | 16,090 | 6/1/94; $3 |
| DCA | Ronald Reagan Washington National Airport | Washington, DC | 34,913 | 11/1/93; $3 |
| DEN | Denver Int'l Airport | Denver, CO | 96,865 | 7/1/92; $3 |
| DFW | Dallas/Fort Worth Int'l Airport | Dallas, TX | 104,903 | 5/1/94; $3 |
| DTW | Detroit Metropolitan Wayne County Airport | Detroit, MI | 59,405 | 1/1/93; $3 |
| EWR | Newark Liberty Int'l Airport | Newark, NJ | 65,504 | 10/1/92; $3 |
| FLL | Fort Lauderdale–Hollywood Int'l Airport | Fort Lauderdale, FL | 41,900 | 1/1/95; $3 |
| HNL | Honolulu Int'l Airport | Honolulu, HI | 18,929 | 10/1/04; $3 |
| IAD | Washington Dulles Int'l Airport | Washington, DC | 43,608 | 1/1/94; $3 |
| IAH | Houston–George Bush Int'l Airport | Houston, TX | 23,046 | 12/1/08; $3 |
| IND | Indianapolis Int'l Airport | Indianapolis, IN | 15,430 | 9/1/93; $3 |
| JAX | Jacksonville Int'l Airport | Jacksonville, FL | 11,506 | 4/1/94; $3 |
| JFK | New York–John F. Kennedy Int'l Airport | New York, NY | 91,069 | 10/1/92; $3 |
| LAS | Las Vegas–McCarran Int'l Airport | Las Vegas, NV | 75,335 | 6/1/92; $3 |
| LAX | Los Angeles Int'l Airport | Los Angeles, CA | 103,983 | 7/1/93; $3 |
| LGA | LaGuardia Int'l Airport | New York, NY | 45,163 | 10/1/92; $3 |
| MCI | Kansas City Int'l Airport | Kansas City, MO | 20,533 | 3/1/96; $3 |

*(continued)*

**Table 13.4**
*(continued)*

| Airport Code | Airport Name | City, State | Amount (thousand $) | First PFC Date; Amount |
|---|---|---|---|---|
| MCO | Orlando Int'l Airport | Orlando, FL | 64,302 | 2/1/93; $3 |
| MDW | Chicago Midway Airport | Chicago, IL | 34,009 | 9/1/93; $3 |
| MEM | Memphis Int'l Airport | Memphis, TN | 0 | 8/1/92; $3 |
| MIA | Miami Int'l Airport | Miami, FL | 61,756 | 11/1/94; $3 |
| MKE | General Mitchell Int'l Airport | Milwaukee, WI | 9,847 | 5/1/95; $3 |
| MSP | Minneapolis–St. Paul Int'l Airport | Minneapolis, MN | 67,481 | 6/1/92; $3 |
| MSY | Louis Armstrong New Orleans Int'l Airport | New Orleans, LA | 15,957 | 6/1/93; $3 |
| OAK | Oakland Int'l Airport | Oakland, CA | 19,391 | 9/1/92; $3 |
| ONT | Ontario Int'l Airport | Ontario, CA | 9,870 | 7/1/93; $3 |
| ORD | Chicago O'Hare Int'l Airport | Chicago, IL | 121,180 | 9/1/93; $3 |
| PBI | Palm Beach Int'l Airport | West Palm Beach, FL | 12,399 | 4/1/94; $3 |
| PDX | Portland Int'l Airport | Portland, OR | 25,467 | 7/1/92; $3 |
| PHL | Philadelphia Int'l Airport | Philadelphia, PA | 61,255 | 9/1/92; $3 |
| PHX | Phoenix Sky Harbor Int'l Airport | Phoenix, AZ | 72,924 | 4/1/96; $3 |
| PIT | Pittsburgh Int'l Airport | Pittsburgh, PA | 16,530 | 10/1/01; $3 |
| RDU | Raleigh-Durham Int'l Airport | Raleigh, NC | 18,940 | 4/1/03; $3 |
| RIC | Richmond Int'l Airport | Richmond, VA | 6,929 | 5/1/94; $3 |
| RNO | Reno–Tahoe Int'l Airport | Reno, NV | 7,689 | 1/1/94; $3 |
| SAN | San Diego Int'l Airport | San Diego, CA | 33,219 | 10/1/95; $3 |
| SAT | San Antonio Int'l Airport | San Antonio, TX | 15,541 | 11/1/01; $3 |
| SDF | Louisville Int'l–Standiford Field | Louisville, KY | 4,595 | 5/1/97; $3 |
| SEA | Seattle-Tacoma Int'l Airport | Seattle, WA | 59,689 | 11/1/92; $3 |
| SFO | San Francisco Int'l Airport | San Francisco, CA | 68,845 | 10/1/01; $4.50 |
| SJC | Norman Y. Mineta San José Int'l Airport | San José, CA | 17,416 | 9/1/92; $3 |
| SLC | Salt Lake City Int'l Airport | Salt Lake City, UT | 36,323 | 12/1/94; $3 |
| SMF | Sacramento Int'l Airport | Sacramento, CA | 21,490 | 4/1/93; $3 |
| SNA | John Wayne Airport, Orange County | Costa Mesa, CA | 16,993 | 7/1/06; $4.50 |
| STL | Lambert–St. Louis Int'l Airport | St. Louis, MO | 24,299 | 12/1/92; $3 |
| TPA | Tampa Int'l Airport | Tampa, FL | 33,518 | 10/1/93; $3 |

Source: Air Transport Research Society database.

not profit maximizing; rather they were set to recover the capital costs of the airport terminal and runway over a given number of years, with an assumption as to how much would be paid by greater traffic when the capacity constraints of the congested terminal and runway were removed. Vancouver opened a new runway and terminal in 1996 with no increase in its aeronautical charges. Effectively, the AIFs paid for the expansion, with none of the costs added on to landing or terminal fees. Since then (and at other Canadian airports), new capital costs have been borne by a combination of AIFs and increased landing charges. It is difficult to sort out the mix without detailed data from the airports, however.

Table 13.5 lists AIF amounts collected at eight major Canadian airports in 2009, as well as their fee schedules as of 31 March 2011. In effect, the federal government anticipated the charging of AIFs when it contemplated the airport transfers in the late 1980s. The first four airports transferred, all in 1992, were Vancouver, Montreal, Edmonton, and Calgary. The Airport Transfer Act of the same year made it clear that the airports could charge AIFs. The next two airports transferred were Toronto and Winnipeg, both in 1995. Most other airports were transferred over the following three years. Not all had AIFs at first. Thunder Bay had an AIF, but then removed it.

Table 13.5 also shows that the Vancouver airport is the only major Canadian airport with a C$15 AIF. All the others are higher. (The Ottawa and Halifax airports also charge C$15, but both are much smaller than the Vancouver airport.) Toronto charges departing (originating) passengers a much higher rate (C$25) than passengers on connecting flights (C$8). AIFs are likely to continue in

**Table 13.5**
Airport Improvement Fees (AIFs) at Major Canadian Airports

| Airport Code | Airport Name | City, Province | 2009 Amount (thousand C$) | AIF Schedule, 31 March 2011 (C$) |
|---|---|---|---|---|
| YEG | Edmonton Int'l Airport | Edmonton, AB | 37,731 | 20 |
| YHZ | Halifax Int'l Airport | Halifax, NS | 15,960 | 15 |
| YOW | Ottawa Int'l Airport | Ottawa, ON | 23,881 | 15 |
| YUL | Montréal–Pierre Elliot Trudeau Int'l Airport | Montréal, QC | 91,106 | 25 |
| YVR | Vancouver Int'l Airport | Vancouver, BC | 75,783 | 5 BC/Yukon<br>15 otherwise |
| YWG | Winnipeg Int'l Airport | Winnipeg, MB | 25,364 | 20 |
| YYC | Calgary Int'l Airport | Calgary, AB | 78,040 | 22 |
| YYZ | Toronto Pearson Int'l Airport | Toronto, ON | 229,806 | 25 originating;<br>8 connecting |

Source: Air Transport Research Society database; www.aircanada.com.

Canada until airport authorities have amassed a sufficiently large base of retained earnings to enable the debt markets to fully finance incremental airport investment in infrastructure.

In Canada the airlines insisted on the right to veto airport capital plans as a condition of collecting AIFs for the airport. Some airports, such as Vancouver, refused this condition for several years and thus collected AIFs themselves. In the United States, the airlines must collect PFCs by law. However, the FAA can reject an airport's request to require airlines to collect PFCs, so it essentially has a veto. There is no similar regulatory power in Canada. Instead, the airlines have the ability to delay airport capital spending they do not want. Eventually (roughly three to four years), the airport can proceed, and the airlines will collect AIFs for the programs.

In both the United States and Canada, airport improvement fees have gradually become one of the most important sources of revenue for airports. In 2007 the fees added about 3 percent to the average cost of a domestic airline ticket sold in the United States (Karlsson et al. 2007). To examine the issue further, the fees at the 63 (sample) airports listed in tables 13.4 and 13.5 were compiled for the period 2001–2009 (with a total of 567 observations). Table 13.6 shows that at the sample mean, AIFs were 48 percent of the airports' aeronautical revenues.[6] Although these fees were less than the airports' operating revenues for all the sample observations, some were higher than their aeronautical revenues (up to 1.9 times higher). On average, AIFs accounted for 22 percent of the airports' operating revenues.

**Table 13.6**
Summary Statistics of Sample Airports, 2001–2009

| | Mean | Std. Dev. |
|---|---|---|
| AIF | 3.91e + 07 | 3.62e + 07 |
| AIF/aeronautical revenues | 0.48 | 0.30 |
| AIF/operating revenues | 0.22 | 0.14 |
| Number of passengers | 2.05e + 07 | 1.71e + 07 |
| Percentage of nonaeronautical revenues | 0.50 | 0.12 |
| Percentage of international passengers | 0.11 | 0.14 |

Notes: For U.S. airports, AIF was in the form of passenger facility charge (PFC). The sample airports are those listed in tables 13.4 and 13.5 (63 total). Total number of observations = 567.
Source: Air Transport Research Society database.

6. For simplicity here and in tables 13.6 and 13.7, AIF is used to represent airport improvement fees in both Canada and the United States.

To see how the ratios of AIFs to aeronautical revenues and AIFs to operating revenues changed over time, these two variables were regressed against year dummies, with 2001 as the base year, while controlling for variables such as a Canada dummy (with U.S. airports being the base), total number of passengers, percentage of international passengers, and percentage of nonaeronautical revenues (based on total operating revenues). Since the ratios have an upper bound of 1, an ordinary least squares (OLS) regression model might introduce a truncated bias. Thus, the Tobit regression model was used instead. The results are given in table 13.7. It is clear from the table that AIFs have become a more important revenue source for airports since 2001.

Table 13.7 also shows that the ratios of AIFs to aeronautical revenues and AIFs to operating revenues increased in the number of total passengers at the airport and the share of nonaeronautical revenues, but decreased in the percentage of international passengers. Thus, AIFs are a more important revenue source for a large airport than for a small one. This may reflect the fact that the U.S. government has gradually reduced its grants to large airports. Furthermore, although

**Table 13.7**
Regressions of AIF/Aeronautical Revenues and AIF/Operating Revenues, 2001–2009

| | AIF/Aeronautical Revenues | | | AIF/Operating Revenues | | |
|---|---|---|---|---|---|---|
| | Coeff. | Std. Error | P > \|t\| | Coeff. | Std. Error | P > \|t\| |
| Canada | 0.7014 | 0.0329 | 0.0000 | 0.4100 | 0.0166 | 0.0000 |
| Number of passengers | 6.81e − 09 | 5.40e − 10 | 0.0000 | 3.28e − 09 | 2.72e − 10 | 0.0000 |
| Percentage of international passengers | −0.7355 | 0.0789 | 0.0000 | −0.4774 | 0.0398 | 0.0000 |
| Percentage of nonaeronautical revenues | 1.4764 | 0.0702 | 0.0000 | 0.2289 | 0.0351 | 0.0000 |
| 2002 | 0.0374 | 0.0337 | 0.2670 | 0.0171 | 0.0170 | 0.3160 |
| 2003 | 0.0735 | 0.0337 | 0.0290 | 0.0319 | 0.0170 | 0.0610 |
| 2004 | 0.0657 | 0.0337 | 0.0520 | 0.0285 | 0.0170 | 0.0940 |
| 2005 | 0.1002 | 0.0336 | 0.0030 | 0.0539 | 0.0169 | 0.0020 |
| 2006 | 0.0944 | 0.0336 | 0.0050 | 0.0460 | 0.0169 | 0.0070 |
| 2007 | 0.1051 | 0.0336 | 0.0020 | 0.0491 | 0.0169 | 0.0040 |
| 2008 | 0.0836 | 0.0336 | 0.0130 | 0.0353 | 0.0169 | 0.0380 |
| 2009 | 0.0846 | 0.0336 | 0.0120 | 0.0372 | 0.0169 | 0.0280 |
| Constant | −0.4897 | 0.0467 | 0.0000 | 0.0020 | 0.0234 | 0.9310 |

Notes: For U.S. airports, AIF was in the form of passenger facility charge (PFC). The sample airports are those listed in tables 13.4 and 13.5 (63 total). Total number of observations = 567.

there is a perfectly linear relationship between AIFs collected and total number of passengers, the positive relationships between the AIF ratios and total passengers do not appear obvious a priori. AIFs are also a less important revenue source for airports with a higher share of international passengers. Given that international passengers have a greater tendency to use connecting flights than domestic passengers, it appears that AIFs are a less important revenue source for airports with a higher share of connecting passengers. Finally, Canadian airports charge significantly higher AIFs than U.S. airports. This finding was expected, given the fee schedules indicated in tables 13.1, 13.4, and 13.5.

These findings suggest that AIFs in Canada appear to be based on the user-pays principle. This is also true in the United States, although that has not always been the case. For the first three decades, the revenues from the ticket tax (5 percent of all airfares in 1941; now 7.5 percent) were transferred to the general fund to support all kinds of government functions (Huang and Kanafani 2010). In the late 1960s, however, the user-pays principle became popular. Its basic assertion is that air travelers, not the general public, should pay for maintaining the U.S. aviation network and, by the same token, that the money collected from them should not be used for expenditures unrelated to aviation. In response, Congress set up the Airport and Airway Trust Fund (AATF) in 1970, and since then ticket tax revenues have gone directly into the AATF and been earmarked for aviation-related outlays. The three takeoff taxes introduced more recently, including the PFC, also are based on the user-pays principle.

The user-pays principle has been justified by the argument that passengers receive airport infrastructure and security services, as well as air traffic control services, in exchange for the payment of these taxes and fees. Much research has been done on user benefits and how to quantify them. For instance, Cohen and Coughlin (2003) and Cohen and Morrison Paul (2003) observed that airports in the United States have become increasingly congested, leading to delays for business travelers and freight shipments. Airport infrastructure expansions to enhance air traffic flows can, therefore, confer travel-time savings and reliability benefits on travelers and shippers. Wei and Hansen (2006) divided passengers' benefits resulting from airport capacity expansion into two categories: indirect benefits and direct benefits. Indirect benefits are obtained through airlines' adaptation and service improvements after expansion. For example, due to increased runway capacity, airlines provide more flights and more connection opportunities for passengers; passengers experience less waiting time and consequently believe it is more convenient to take a trip. Direct benefits result directly from airport expansion. For example, if airport capacity is increased, passengers enjoy more on-time flights and experience less congestion.

## *Benefit Spillovers of Airport Infrastructure*

Policy makers, business leaders, media, and the public commonly believe that airports are economic engines that affect not only air passengers, but also a variety of other stakeholders in the wider economy.[7] This section examines local benefit spillovers—namely, urban economic development and increases in employment and tourism—in relation to airport infrastructure.

A number of empirical studies have demonstrated a strong link between air service and employment, investment, and urban economic development. Irwin and Kasarda (1991) examined the relationship between the structure of airline networks and employment growth in 104 metropolitan areas in the United States. Using data from 1950 to 1980, they conducted regression analysis relating employment in the manufacturing and service sectors of each metropolitan area to a number of explanatory factors, including population, road infrastructure, telecommunication infrastructure, and measures of the airline network serving the area. This analysis showed that the expansion of the airline network had a significant positive impact on employment in the region. The effect was particularly significant in the service sector, as businesses such as management consulting, finance, and accounting firms tend to locate in areas that minimize constraints on contact and maximize access to geographically dispersed markets. Using nonrecursive econometric models, these authors also found that increases in the airline network were a cause rather than a consequence of employment growth in both the service and manufacturing sectors.

Goetz (1992) correlated the volumes of air passenger flows per capita with changes in population and employment for the 50 largest U.S. metropolitan areas between 1950 and 1987. Although he did not establish a causal relationship, he found that airport capacity was an important condition for growth in most regions.

Button et al. (1999) related the level of high-technology employment in a sample of 321 U.S. metropolitan areas to a number of explanatory variables, including a dummy variable indicating whether the area's airport was one of the nation's 56 largest. After addressing the issue of causality (i.e., do larger airports lead to greater employment, or does greater employment lead to larger airports?) with the Granger causality test, the authors found that airport size had a positive impact on high-tech employment. Button and Taylor (2000) examined the link between international air service and economic development. Using data for 41 metropolitan areas in the United States, they regressed "new economy" employ-

7. For instance, in March 2011 the City of Chicago reached a $1.17 billion agreement with American Airlines and United Airlines on a plan to proceed immediately with the completion of the O'Hare Modernization Program (OMP). During the post-agreement ceremony, Mayor Richard M. Daley said, "O'Hare International Airport is the economic engine that drives the economy of our city, our region and our state and connects Chicago to the world. Unless we continue to modernize its infrastructure and operations, we will lose our competitive edge in the global economy . . . The OMP keeps businesses thriving, residents working and our economy growing" (U.S. Department of Transportation 2011). The OMP is one of the largest construction projects in the United States. When the program is completed, O'Hare will have eight modern runways, reducing flight delays and improving efficiency for travelers throughout the country.

ment against a number of control factors, including the number of direct routes to Europe offered by airports in the region. The study confirmed the anticipated connection between "new economy" jobs and air service to Europe. In both of these studies, "accessibility to air cargo services" appeared to play a catalytic role in driving the results. In addition to frequent travel by employees in the high-tech and "new economy" sectors, the movement of high-value, just-in-time cargoes likely plays an important role in these sectors.

In an attempt to improve on previous work discussed above, Brueckner (2003) offered additional empirical evidence and insights regarding the link between air service and economic development. He regressed employment in 94 metropolitan areas in the United States against a number of factors, including one measure of air service, high levels of passenger enplanements. Controlling for reverse causality between employment and air traffic, the analysis found that a 10 percent increase in passenger enplanements led to an approximately 1 percent increase in employment in service-related industries. There was no impact on manufacturing and other goods-related employment, suggesting that air travel is less important in these industries than in service-related industries. Labor costs are often less of a factor in service-related industries than customization and proper design, which require more person-to-person communication. Air travel is an important element of such communication.

As Brueckner (2003) points out, frequent service to a variety of destinations facilitates face-to-face contact with people in other cities, thus attracting new firms to the area and stimulating employment at established enterprises. Furthermore, by facilitating face-to-face contact with collaborators in other cities, good air service fosters what the author calls "intercity agglomeration economies." These intercity effects complement the agglomeration economies that occur among firms within a given city, whose importance has been demonstrated by empirical work on agglomeration. See, for example, Glaeser et al. (1992) and Rosenthal and Strange (2001). For a recent survey of the literature, see Glaeser and Gottlieb (2009). This agglomeration literature suggests that good air service could enhance, via intercity agglomeration economies, urban economic development.

The spillover of airport infrastructure to urban economic development includes its catalytic role in business investment and labor productivity. For instance, Hansen and Gerstein (1991) investigated the relationship between Japanese air service to the United States and Japanese direct investment in the United States. Using data from 1982 to 1987, the analysis related the amount of Japanese investment in each U.S. state to measures of level of air service between Japan and that state (and other background factors). The analysis found that air service had a positive causal effect on investment. The authors further concluded that more air service supported the input needs (i.e., labor and materials) of Japanese ventures in the United States and enabled greater awareness of and information flows to Japan regarding U.S. regions with such service.

Cohen and Morrison Paul (2003) found that airport infrastructure expansion had a "cost savings" effect on own-state manufacturing production. These savings were due to the increased productivities of workers (both production and nonproduction workers) and materials resulting from the enhanced traffic flow and reliability of the transport network following the expansion.[8] Further, incentives for private capital investment, and the resulting growth of manufacturing industries, are implied by increased private capital shadow values from airport infrastructure expansion.

The airline industry provides the foundation for tourism, by many measures the world's largest single industry. Several economic analyses have captured the link between aviation and tourism. For example, Desalvo (2002) estimated the impact of an airport on total visitor spending in a region, after introducing a method to avoid the overestimation problem. He applied the model to Tampa International Airport and concluded that the airport brought an additional \$35 million in visitor spending to Hillsborough County, Florida, in 1996. This finding confirms the contribution of a convenient airport to regional development through its support of tourism.

After examining the factors affecting the sluggish growth of tourism in India, Raguraman (1998) concluded that the inactive role of government in developing aviation infrastructure, together with its protective aviation policy, hampered the growth of tourism. After surveying the literature, Forsyth (2006) noted that the relevance of tourism's economic benefits in aviation policy decisions had been established, but there had been little analysis of how those benefits could be measured. The author used computable general equilibrium models of economies to measure the benefits. He found that the measures obtained from these models were significantly positive and relevant to aviation policy making.

Finally, there is a large body of studies, sometimes referred to as the "economic impact studies," that have attempted to estimate the economic impacts of the aviation industry on the local economy. A common theme of these studies is the identification of aviation's contributions in terms of a region's gross domestic product (GDP) or total employment, after accounting for both its direct and indirect benefits (with the latter being the so-called multiplier effect). One of the widely adopted methods here is the counterfactual approach. Using this approach, Raguraman (1997) estimated the benefits of additional weekly flights between India and Thailand to the local economy in India. Benell and Prentice (1993) used a regression approach to predict the economic impact of Canadian airports on the local economy.

8. Using a similar idea that "cost savings" effects arise primarily from enhanced worker mobility and thus productivity, InterVISTAS Consulting (2008) focused on the labor cost impacts of airport infrastructure expansion in a sample of world airports. The study confirmed the positive link between infrastructure expansion and productivity.

With the help of an input-output table, Inshikura, Tansei, and Sugimura (2003) applied the computable general equilibrium model to study the impact of airport development on different economic sectors in Japan. Under the assumption of a 10 percent improvement in productivity and a 10 percent reduction of air travel time resulting from airport development, most of the sectors studied saw a decrease in prices (with the largest decline, 4.6 percent, in the air transport sector itself) and increases in output (with the manufacturing sector experiencing the largest increase) and final demands. They concluded that airport development is critical to the Japanese economy.

Fung, Law, and Ng (2006) quantified the economic contribution of Hong Kong's aviation sector by using the value-added approach, capturing the direct and indirect benefits of aviation across four sectors: air transport, services that are incidental to air transport, tourism, and trade services. Air transport and incidental services benefit directly from aviation. Tourism and trade services, which are supported by air transport services, benefit indirectly. The authors compared the value added of each sector at current prices with Hong Kong's GDP at the factor cost (at current prices) to estimate the direct and indirect effects of the aviation sector on the Hong Kong economy. They found that the direct and indirect impacts together accounted for about 6.5 percent of Hong Kong's GDP.

Although these economic impact studies confirmed that the presence of airport infrastructure positively affects local economies, the findings need to be interpreted with caution. With regard to the counterfactual approach, for instance, since no one knows exactly how economic development would have evolved without the airport, factors must be carefully specified and sensitivity analysis must be taken in such studies. For example, although the businesses developed might not exist if there had been no airport, other industries might have flourished, and their benefits should be carefully measured (see, e.g., Fung, Law, and Ng 2006). Furthermore, evaluating airport investment in terms of maximizing regional development would require a comparison of the regional impacts of such investment with the impacts of investment in other sectors, such as manufacturing, education, or health. In addition, as discussed in Fung, Law, and Ng (2006), some impact studies suggest that the presence of an airport generates intangible economic benefits for the region (e.g., raising the status of the region and attracting national and world recognition that enhances the business prospects and even the self-esteem of the community), but these benefits were not measured in a rigorous way.

## *Paying for Airport Infrastructure*

The common view in the literature seems to be that an airport improves an area's connection with the rest of the world, and that connection brings many benefits. For instance, convenient and reliable air transport provides an incentive for tourists to travel to the area. This benefits not only local air carriers, but also restaurants, hotels, transportation providers, and other retail and service businesses. As a result of a closer connection with the rest of the world and the associated benefit spillovers, the area's land values increase. Standard intercity spatial equilibrium models show that land values rise with improvements in either productivity or quality of life.[9] An airport, distinct from airline flight services, might be considered a local public good, and its net benefit (its social value net of infrastructure improvement costs) is capitalized in the region's land values.

If an airport is no different from a public road in that it provides a public good, should other people, in addition to airline passengers, pay for the airport's infrastructure development? There is no easy answer to this question, and opinions among economists differ widely.

## SELF-FINANCING THEOREM

As discussed earlier, airport infrastructure in the United States and Canada is financed largely by direct users (airline travelers).[10] For example, U.S. ticket tax revenues go into the Airport and Airway Trust Fund (AATF) and are earmarked for aviation-related outlays. The three takeoff taxes, including the PFC, also can be seen as applications of the user-pays principle. While some people call these fees taxes, others point out that they are really user fees: taxes are inescapable, but fees can be avoided, in this case by deciding not to travel or by using an alternative airport or mode of transportation.

A counterpart of the AATF in the United States is the Highway Trust Fund (HTF), which was established in 1956 to finance the interstate highway system. Funding for the HTF comes from the federal fuel tax, which as of January 2012 was 18.4 cents per gallon on gasoline and 24.4 cents per gallon on diesel fuel, along with related excise taxes (API 2012). Until 1982 this money was earmarked for roads, but in that year the Mass Transit Account was established, introducing a degree of cross-subsidization between travel modes. Some economists, especially Gabriel Roth (2005), have been critical of this cross-subsidization.

In effect, airports, like roads, are an impure public good: They are rivalrous when the utilization rate is high enough, and they are excludable. Under the conditions of the self-financing theorem (Mohring and Harwitz 1962), revenues from congestion charges will just pay for a facility, and there is no need for subsidization. But due to capacity indivisibilities and scale economies, deficits are common.[11] A tension then arises between the principles of marginal social cost

9. For a comprehensive literature review, see Glaeser and Gottlieb (2009). For an example of recent empirical work, see Zheng, Fu, and Liu (2009).

10. Not all infrastructure- and security-related costs in the United States are covered by the infrastructure and security taxes and fees paid by airlines and their customers. For example, during the period 1997–2006, up to 24 percent of the FAA's annual budget came from general fund contributions (Air Transport Association 2007).

11. Some analysis shows that the self-financing theorem can fail if airlines have market power at the airport. See, for example, Brueckner (2002) and Zhang and Zhang (2006).

pricing and the user-pays principle. There is a long-standing debate in the literature on this; see Lindsey (2006) for an extensive discussion.

### BENEFICIARY PRINCIPLE

If people other than direct users benefit from airports, roads, high-speed rail lines, or other facilities, the beneficiary principle provides a case for charging them (Nash 2007; Vickerman 2005). It is frequently argued that roads and other types of transport infrastructure contribute to economic development. This theme was addressed by Gkritza et al. (2008) and Weisbrod (2008) in a special issue of the *Annals of Regional Science*. They highlighted the importance of including all relevant impacts of projects, while at the same time avoiding double counting. In the same special issue, Vadali (2008) examined the effects of toll roads in Dallas County, Texas. Other sources of information on the subject include Brueckner (2003) and Graham (2007) on agglomeration economies; Cohen and Morrison Paul (2003, 2004) and Laird, Nellthorp, and Mackie (2005) on network effects; Haynes and Button (2001) and Vickerman (2007) on economic development; Jensen-Butler and Madsen (2005) on regional growth; and Mackie and Preston (1998) on pitfalls in transport appraisal.

A related idea is for the government to provide subsidies for infrastructure development. Subsidies can, in general, be justified on either efficiency or distributive grounds. For example, a subsidy could be justified if the unsubsidized market would supply too little of the good. This is the classic situation of positive externalities: the subsidy would induce greater provision of the good. The "lumpy" nature of runways and terminals may provide another justification for a subsidy.

### EQUITY

In addition to the efficiency consideration, subsidies could be justified as a means of redistribution. For example, public education is paid for out of taxes, with wealthier individuals paying more in taxes than the cost of the services they receive and poorer individuals paying less than the full cost of the services. In effect, air transportation used to be considered a luxury good and was taxed as such. Today, however, in the United States, Canada, and Europe, more than 40 percent of airline trips are taken to visit friends and relatives, and about 30 percent occur on low-cost carriers. While the notion of air transportation being a luxury good might be misplaced, it would be hard, as far as equity is concerned, to argue that airport users should be subsidized, since they appear to remain wealthier than the average citizen.

A possible objection to airport improvement fees is that users are paying for the construction or expansion of a facility that will not be available for some time and that they may never use. This raises the issue of intertemporal equity, which is prominent in the debate on budget deficits and social security. On one hand, this objection may be especially pertinent to Canadian airports because of their not-for-profit status. On the other hand, the "two charges" approach at

Vancouver International Airport (i.e., passengers departing the airport pay C$5 for travel within British Columbia and Yukon Territory, but C$15 for travel to other destinations) may be viewed as being consistent with Ramsey pricing. The airport recognized that there would be elasticity responses to an AIF and sought to minimize the loss of traffic.

Another equity issue is related to the consequences of takeoff-based AIFs. As pointed out by Huang and Kanafani (2010), escalating airport takeoff taxes may force airlines to give up smaller communities that can sustain only connecting services to other parts of the country. Their research regarding PFCs showed that in response to a takeoff tax, airlines overshift the tax onto their nonstop passengers, while leaving connecting fares little changed. They thus argue for the need to introduce peak-load congestion pricing and suggest using the extra revenues to fund investments that will lower long-run service costs at the airports—and hence PFCs—an idea that has been advocated by economists since the 1960s (see, e.g., Levine 1969; Mohring and Harwitz 1962; Vickrey 1969).

At this time, airport improvement fees are imposed mainly on passengers rather than owners of air cargo (shippers). There are, however, federal taxes on airfreight waybills, similar to the ticket tax on passengers. For decades airlines and airports served predominantly passenger markets, and their operations and infrastructure were primarily designed to match the needs of people. To a large extent, airfreight played a complementary role, filling up excess capacity of passenger aircraft. In recent years, however, globalization and the emergence of the Internet have led to a huge air cargo market. Between 1979 and 2009, global airfreight grew by 5.1 percent annually. For a number of airports, the volume of air cargo has risen to a point where it is, in fact, competing with passengers for airport facilities, security, air traffic management, and airport access/egress infrastructure (e.g., roads and other intermodal connections). For instance, it is not uncommon to find traffic congestion on runways, on air traffic control, or on the roads around airports caused by both passengers and cargo. The extra revenues generated by levying airport improvement fees on shippers for the development and operation of both on- and off-airport facilities and infrastructure could be used to fund investments that would lower long-run service costs, thereby lowering passenger facility charges.[12]

## LAND VALUE CAPTURE MECHANISMS

As discussed earlier, a large percentage of the cost of an airline ticket goes toward infrastructure-related costs. Airport improvement fees are the established mechanism for funding airport infrastructure and have, over the years, become

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12. Airfreight has also become "less footloose" than before, as just-in-time service and prompt delivery have become increasingly important in recent years. Air transport, which provides a speedy delivery service, is one of the best choices for businesses. Furthermore, airlines and freight forwarders now need to make huge (irreversible) investments in cargo facilities at airports.

a more important revenue source for airports. Yet an airport improves an area's connection with the rest of the world, which may bring many benefit spillovers to the region. As a result of these benefits, land values in the area are likely to increase.[13] The airport's net benefit (social value net of improvement costs) may be capitalized in the land values.

The recent research on urban agglomeration economies is well-grounded theoretically, but there are still relatively few estimates of the magnitude of the scale economies. It would be difficult to justify a particular level of taxation on, say, businesses that reside within a given distance of an airport, or within its hinterland. Yet landowners are sometimes assessed for increases in the value of their land due to the expansion of subway or light-rail lines. And road improvement fees are levied on new developments that require upgraded roads. In these instances, however, the transit lines or roads are much closer to the land uses they serve than an airport is to its hinterland, which could extend out for tens of miles.

One land value capture mechanism may be for airports to charge concession fees for a large variety of nonaeronautical services. Airports may, for example, rent space for commercial activities, including airline business-class lounges or land for cargo and maintenance facilities. They might charge fees for advertising and other displays; for the provision of Internet, phone, and electric service; or even for commercial transportation vehicles' use of curb space. Land rental rates may differ depending on the use. For instance, airports provide land at cost recovery for services, such as aircraft maintenance, that must be located contiguous to the airfield. Other facilities, such as catering and cargo, may *prefer* to have airside access, but they do not absolutely require it, and so they may be charged somewhat higher rental rates. Land that is available but is not essential for airport operations may be rented at full commercial rates for nonaviation-related uses, such as shopping centers, in order to generate additional revenues for the airport. These revenues might be reinvested in airport infrastructure, which would lighten the burden of AIFs on passengers.

Whether the additional revenues would be reinvested in airport infrastructure or not would depend on airport governance or regulation. In Canada any profits would eventually be reinvested in the airport, because airport authorities are not-for-profit organizations. More generally, airport aeronautical charges are

13. Efficient air transportation can also be an important factor in supporting a high-wage economy. Workers want to earn high wages, but increasing wages too much can make the local economy uncompetitive. How can the disadvantage of paying workers high wages be overcome? The answer lies in leveraging productivity gains in other parts of the production chain. By having access to an efficient, reliable air transportation network, firms can achieve a productivity gain or a cost reduction. The cost reduction is realized through a combination of reduced transportation and inventory costs, as reliable, speedy transportation allows firms to provide the same level of customer service with lower inventory levels. The savings in total costs can then be used to offset higher wages.

subject to some form of government regulation in most countries, owing largely to a desire to contain the market power of airports, which have the potential to become local monopolies.[14] The exact form of price regulation varies both across countries and over time. For example, a number of countries have adopted cost-based, rate-of-return (ROR) regulation, while price-cap regulation has been popular in countries such as the United Kingdom, Denmark, Ireland, and Australia.

Under both ROR and price-cap systems, there are two versions of price regulation: the single-till approach and the dual-till approach. The distinction between the two approaches is related to how an airport generates revenue. Airport revenue is derived from two facets of its business: traditional aeronautical operations and concession operations.[15] The former include aviation activities associated with runways, aircraft parking, and terminals. The latter encompass all nonaeronautical activities that occur within terminals and on airport land, including terminal concessions (duty-free shops, restaurants, etc.), car rental, and car parking. For the past two decades, one of the most striking and consistent trends in the airport sector has been the growing importance of nonaeronautical revenues. As a result, these revenues have become the main source of income for many airports.[16] Under single-till regulation, revenues from both aeronautical and concession operations are considered in the determination of airport charges. Under dual-till regulation, charges are determined based solely on aeronautical activities.

Unlike aeronautical revenues, nonaeronautical revenues are largely unregulated. Due partly to the prevailing regulations and charging mechanisms, concession operations are more profitable than aeronautical operations (see, e.g., Starkie 2001). Under dual-till regulation, passengers also contribute to infrastructure improvement indirectly through mechanisms such as concession fees charged by airports. This contribution is in addition to passengers' direct payments, such as AIFs, for infrastructure and gives rise to the question of equity. For example,

14. While there are no ex ante price regulations for airports in Australia and New Zealand, these airports are subject to price monitoring by government regulators (ex post regulation). The United Kingdom did not allow the "designated airports" (Heathrow, Gatwick, Stansted, and Manchester) "to freely set charges" until the very recent substitution of ex post regulation (Bilotkach et al. 2011). For most airports in the world, however, aeronautical charges are formally regulated.

15. Concession operations are often called commercial operations.

16. Van Dender (2007) investigated 55 large U.S. airports from 1998 to 2002. The author found that although the percentage of concession revenues dropped with the slump in air travel in 2001 and 2002, it still represented more than half of total airport revenues. According to table 13.6 earlier in this chapter, the 63 airports reviewed here derived as much income, on average, from nonaeronautical revenues (50 percent) as they did from aeronautical revenues (48 percent). For earlier studies on the importance of concession revenues, see Zhang and Zhang (1997).

opening new retail concessions may require expansion of the terminal, which in turn triggers the collection of AIFs to fund the expansion. The expanded terminal then generates more concession profits, which accrue to the airport operator. This can be especially troublesome in regard to private airports. Starting with the privatization of airports in the United Kingdom in the late 1980s, more and more airports have been privatized (or partially privatized) around the world, including in Europe, Oceania, Asia, South America, and Africa.

In contrast, under single-till regulation, the indirect contribution mechanism described in the previous paragraph is absent. Aeronautical charges are likely to be set lower than under dual-till regulation, owing to the cross-subsidy from the usually profitable (unregulated) commercial operations. In other words, the single-till approach usually leads to reduced charges for aeronautical services.[17] Single-till regulation may, therefore, represent a more equitable approach to the funding of airport infrastructure than dual-till regulation.[18] Yet airport operators generally support the dual-till approach, as it usually results in higher aeronautical user charges and higher overall profits (Odoni 2009).

Finally, as pointed out by Jorge and de Rus (2004), the existing cost-benefit approaches focus on airports as transport infrastructure. This means that revenues from nonaviation activities—mainly retail operations, but also land rental for other industrial activities—are not to be counted as economic benefits resulting from airport investment. Taking such benefits into account would give a more comprehensive view of project benefits and would likely put downward pressure both on aeronautical charges and on AIFs and other taxes and fees paid by passengers. Jorge and de Rus suggest that when doing a full cost-benefit analysis, it is necessary to estimate such revenues in order to estimate the financial return of the project and to gauge any necessary adjustments to aeronautical airport charges resulting from project implementation.

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17. Using a unique data set collected for a German airport efficiency program and including 61 airports over the years 1990–2007, Bilotkach et al. (2011) found that airport charges were lower where single-till regulation was used. Their empirical analysis relied on panel data and generalized method of moments.

18. Zhang and Zhang (1997) and Czerny (2006) point out, in different contexts, that such cross-subsidization can be welfare enhancing at uncongested airports. At congested airports, dual-till regulation can be more desirable than single-till regulation, however, because the economic efficiency of constrained airport capacity requires higher aeronautical charges (Yang and Zhang 2011). For this reason, Beesley (1999) argues that the single-till price cap is inappropriate for Heathrow, a heavily congested gateway airport in the United Kingdom. Beesley also notes that it might be difficult to isolate aeronautical activities from concession activities, thus making it difficult to implement dual-till regulation in practice. Finally, we note that airport charges can be constrained by international regulations. For example, the single-till approach was required for U.K. airports under international air travel agreements into the 1990s.

## *Conclusions*

A large percentage of the cost of an airline ticket goes toward infrastructure-related costs. Airport improvement fees are the established mechanism around the world for funding airport infrastructure and have, over the years, become a more important revenue source for airports. These fees charge passengers for airport infrastructure development and/or debt repayment at higher rates on departing than on connecting flights.

One land value capture mechanism is for airports to charge concession fees for a large variety of nonaeronautical services. Furthermore, land rental rates may differ depending on the use. In particular, land that is available but is not essential for airport operations may be rented at full commercial rates for nonaviation-related uses, such as shopping centers, in order to generate additional revenues for the airport. These revenues might be reinvested in airport infrastructure, which would lighten the burden of AIFs on passengers.

Whether the additional revenues would be reinvested in airport infrastructure would depend on airport governance or regulation. Under dual-till regulation, passengers contribute to infrastructure improvement indirectly through concession fees. This contribution is in addition to passengers' direct payments, such as AIFs, for infrastructure and gives rise to the issue of equity. This issue may be of particular concern to private airports. In contrast, the indirect contribution mechanism is absent under single-till regulation.

Finally, it may be desirable to take nonaviation revenues into account when evaluating airport improvement projects. Doing so would likely put downward pressures on AIFs and other taxes and fees paid by passengers.

Although this chapter focuses on *local* benefit spillovers, airport infrastructure investment also generates *network* externalities or spillovers, as demonstrated by Cohen and Morrison Paul (2003) and Ueda et al. (2005). In particular, Cohen and Morrison Paul (2003) found, using U.S. data, that in addition to the substantive impacts of own-state airport infrastructure on manufacturing industry costs and productivity, airport expansion in "connected states" had a comparable effect in states with hub airports and an even greater impact in other states. This suggests that high congestion in passengers' destination states relative to their origin states implies greater cost effects from other than own-state airport expansion. This network externality should also be taken into account when pricing and funding infrastructure. For instance, because of network externalities, the market price may fail to convey the real value of a service or product, and therefore networks may tend to be smaller than desirable. This issue, together with several others, remains an important avenue for further research.

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