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A price forecasting model for predicting value of commercial airports: a case of three Korean airports

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Abstract

As the privatization of airports progresses throughout the world, the economic value of these strategic assets must be determined from a commercial perspective, rather than the economic impact perspective, which is typically used by governmental agencies to justify their construction. This paper applies financial theory of asset valuation to commercial airports. The authors have selected three airports for valuation purposes: Gimpo, Kimhae and Jeju. These airports are ranked top three in terms of annual traffic volume, among the 16 airports operated by Korea Airport Corporation ("KAC"). The authors estimate the intrinsic value of three major airports; Gimpo, Kimhae, and Jeju based on the discounted cash flow (DCF) model at $1.8 billion. The ultimate price achieved depends on the individual expectations of potential buyers, their opportunity costs and entrepreneurial abilities, as well as the ensuing negotiations. This paper, therefore, provides a benchmark for determining airport valuation in the event of privatization.
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1. Introduction

There are seventeen airports in South Korea that offer scheduled-service by commercial airlines. Incheon International Airport Corporation (IIAC), a government-owned corporation, operates the largest and recently opened airport, Incheon International Airport. The Korea Airport Corporation (KAC), also government-owned, operates the remaining 16 airports.

The objective of this research is to assess the value of three major airports operated by KAC in the event of airport privatization. IIAC has been profitable in terms of gross profit since operations began in 2001. In contrast, many small airports with less than one million annual passengers are operating under their respective break-even point. Therefore, this paper, as an empirical case study, assesses the enterprise value of select, relatively large airports operated by KAC using an appropriate valuation model. The valuation of the airports is

ultimately based on their potential revenue generation and cost structure.

Section 2 reviews the air transport industry and airport systems in South Korea. A summary of airport privatization is discussed in Section 3. Section 4 introduces the theory of valuation models, while Section 5 applies the financial theory to the three Korean airports. Section 6 discussed the results, and Section 7 concludes.

2. Air transport industry and airport systems in South Korea

In Korea, almost all economic infrastructures are undergoing renovation in response to International Monetary Fund (IMF) mandates from late 1997. The Planning and Budgeting Board has been established to take responsibility for this renovation and to formulate the policies and the laws to affect this dramatic renovation. The Board instituted the laws to privatize the public enterprises. The law to corporatize and privatize airport systems is one of them. Currently, two domestic

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air carriers operate in the market, Korean Air Lines (KAL) and Asiana Airlines. KAL is a member of the Skyteam global alliance, which includes Aero Mexico, Air France, Alitalia, Czech Airlines, and Delta. Asiana, in June 2002, announced its intention to join the Star Alliance, which includes All Nippon Air (ANA), Air Canada, Lufthansa, and United Airlines, among others.

2.1. Evolution of the Korean commercial airline industry

Although launched in 1948, commercial air transportation in Korea remained in its infancy until 1969. International passenger and cargo services were provided by foreign airlines such as Northwest Airlines, Japan Airlines, and Cathay Pacific Airways. In 1969, Korean Air Lines (KAL) was established, through the privatization of Korea National Airlines. Influenced by rapid economic development, the demand for international air traffic enjoyed significant growth through 1970s and 1980s. As a result, KAL enjoyed strong demand and considerable growth.

Growth in the Korean aviation industry was further spurred by the 1988 declaration of the "liberalization of foreign travel" act, prior to which foreign travel by the general public was strictly regulated. From 1988 to 1989 alone, the number of international departure passengers jumped by 28.3%. Asiana Air Lines (AAR) was founded as the second scheduled air carrier in February 1988. Both of the airlines enjoyed relatively high growth until late 1997 when the Korean economy entered a recession due to the Asian financial crisis (Asiana Airlines, 2002).

As the Korean economy recovered from the period of stagnation, the demand for air transportation in Korea returned to the pre-crisis level. Korean Air transported 21.6 million passengers and 1.2 million tons of cargo to 83 cities in 29 countries around the world, and experienced growth from 2000 to 2001 of 4% in passenger revenue and 7% in cargo revenue (Korean Air, 2001). It ranked 14th in number of passengers transported, and 2nd in volume of cargo transported among IATA member airlines (IATA, 2001). AAR operated 61 international routes to 53 cities in 16 countries in 2002. Domestically, KAL operated 25 routes to 16 cities, and AAR participated in 18 routes to 14 cities in 2002. According to 2002 data, the fleet of Korean Air was composed of 120 aircraft including eight B777-200, 13 A300-600, 27 B747, and Asiana Airlines operated 64 aircraft.

2.2. Operational and ownership structure of Korean airports

In Korea, 17 airports support scheduled air transport service: five international airports and 12 domestic airports. The central government owns these airports through the Ministry of Construction and Transporta-

tion (MOCT) and through branches of the Ministry of Defense, which operates them through IIAC and KAC. It has been generally recognized that the current system of airport ownership and operation is very inefficient with relatively low service quality. Table 1 shows a summary of the ownership and scale (annual passengers handled) for the airports operated by KAC.

KAC is responsible for the operation and management of civil airports without ownership. The airport functions commissioned to KAC include:

- maintenance and operation of landing field, including runway, taxiway and ramp areas for aircraft movement;
- management of passenger and cargo terminals;
- airport security, fire fighting and accident handling;
- operation and maintenance of Instrument Landing System, Air Navigation facilities, and communication systems;
- environmental protection, including noise, water and air pollution.

The central government owns all the shares of KAC. KAC is able to issue corporate bonds and utilize international debt instruments. Although KAC is allowed to assign the right of airport operations to other organizations, almost all of the work related to airport operation commissioned to KAC is conducted directly by the KAC employees or airlines.

The airports owned and controlled by military units are mainly operated by appropriate military units. The use agreement between the Ministry of Construction and Transportation and the Ministry of Defense was established for the civil use of military airport. The airlines or civil aircraft operators pay a fee to the

Table 1
Ownership and control of KAC's airports

Rank	Airport	Ownership and control	Passenger volume
1	Gimpo Int'l	MOCT	36,637,067
2	Kimhae Int'l	Air Force	9,358,152
3	Jeju Int'l	MOCT	9,125,937
4	Kwangju Domestic	Air Force	2,367,585
5	Taegu Domestic	Air Force	2,086,436
6	Ulsan Domestic	MOCT	1,285,591
7	Pohang Domestic	Navy	789,973
8	Yeosu Domestic	MOCT	654,309
9	Chinju Domestic	Air Force	858,237
10	Kangung Domestic	Air Force	564,669
11	Kunsan	US Air Force	258,005
12	Sockcho Domestic	Army	225,342
13	Yeochon Domestic	Air Force	169,615
14	Chungju Int'l	Air Force	353,728
15	Mockpo Domestic	Navy	372,235
16	Wonju Domestic	Air Force	86,196

Source: Korea Civil Aviation Development Association, Aviation Statistics, Seoul, Korea, 2000.

Ministry of Defense for using military airport facilities, buildings and land. The aircraft landing fees for airline aircraft is paid to the Ministry of Construction and Transportation, while revenue collected by landing charges must be used for the landing field maintenance and operations. The passenger and cargo terminals as well as the accompanying facilities to be used for the ground handling of civil traffic are constructed and maintained by the Ministry of Construction and Transportation. The KAC and the airlines are responsible for terminal operations.

3. Airport privatization

The increasing capital needed to build and maintain commercial airports has created pressure on the public sector to relinquish control and ownership of these airports to the private sector. As a result of changing airline industry structures and diversification of operations, airport operators have begun to shift from residual cost to compensatory fee methodologies [1] (Betancor and Rendeiro, 1999). This shift allows airport operators to profit from landside operations while being adequately compensated for airside operations. This ability to generate profits from landside operations, and the greater flexibility inherent in compensatory agreements enable airports to raise investment capital and thus to be privatized. Furthermore, many examples of airport privatization provide support for the argument that divestiture can enhance the efficiency of airport operations (Truitt and Michael, 1996). Hamzaee and Vasigh (1998) emphasize the benefits of privatization of airports in Western Europe, Latin America, and Asia that should inspire officials in search of new economical opportunities in transforming airports from publicly run into private businesses. Several different approaches can be used to achieve airport privatization. These approaches differ in the degree to which control and ownership is relinquished. Generally, one can differentiate at least among the following forms.

The techniques used to privatize airports vary in terms of the scope of responsibility and, in some cases, the degree of ownership transferred to the private sector. A traditional privatization tool involves the contracting of selected services (restaurants, parking, security services, cargo, baggage handling, fueling services) to the private sector while the government retains overall operating responsibility for the airport. Under the contract management approach, the government transfers responsibility for all airport operations and implementation of strategy to the private sector, while retaining the ownership and investment responsibilities. [2] A long-term lease approach allows the government to retain ownership and to transfer investment, operational and managerial responsibilities. [3] This method may be used to allow the financing of the construction of the airport or associated project by the private sector, which must then relinquish control at the end of the lease term. [4] Finally, using a full divestiture/sale of shares, the government transfers either full or partial ownership to the private sector.

3.1. Background, analysis and trends

Privatization is much more common around the world with the initial wave of airport privatization having started in the United Kingdom. In 1987, the British government completely privatized its seven major airports when it offered British Airport Authority (BAA) to the public for a $2.5 billion. Attracted by the positive results from the United Kingdom model, the trend of airport privatization migrated into other countries. Austria's Vienna Airport was listed on the Vienna Stock Exchange in 1992. In 1994, two Danish Airports were privatized as Copenhagen Airports Ltd.

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[1] Under a compensatory fee approach, airport fees incurred by the airlines are contractually established between the airport and the airlines. Under a residual cost approach, airport fees incurred by airlines are adjusted so as to allow the airport to fully recover its operating costs after subtracting landside revenues. Accordingly, the airlines bear the financial, or equity, risk of the airport under a residual cost fee structure. Under a compensatory fee structure, the financial risk shifts to the airport owner. As such, improvements in operating efficiency or landside revenues accrue to the benefit of the airport owner under a compensatory system.

[2] Several United States airports currently are operated under management contracts. These include Westchester County Airport, Albany County Airport in New York, and Burbank Airport, which is owned jointly by the cities of Burbank, Glendale, and Pasadena, California. The Burbank Airport has been managed by Lockheed Air Terminal, Inc., since 1978. Lockheed receives a fixed management fee, plus expenses for the services it provides for the airport. The airport authority is responsible for capital improvements. Burbank Airport, which ranks 59th in size among United States airports (as measured by annual passenger enplanements), often is held up as a viable model of public–private partnerships in airport operations (Ashford & Moore, 1992, p. 89).

[3] Build-Operate-Transfer (BOT) is a commonly used technique for this option. A variation of this is Build-Own-Operate and Transfer (BOOT).

[4] Several examples of this type of public–private partnership already exist in the United States, including airports in Atlantic City and Morristown, New Jersey. Perhaps the best-known example of such a lease arrangement is Teterboro Airport, in New Jersey. The lease to operate Teterboro was established in 1970, when Pan American World Airways (now known as Johnson Controls World Services) negotiated a lease with Teterboro's owner, the Port Authority of New York and New Jersey. Johnson Controls recognized that general aviation activity was causing congestion and threatening its commercial operations in New York. The company believed that it could relieve some congestion if general aviation aircraft could be lured away from the city. Johnson Controls secured a 30-year lease to operate Teterboro Airport.

and listed on the Copenhagen Stock Exchange. In both of these examples, the respective government sold slightly less than 50% of the shares to the private sector (Betancor and Rendeiro, 1999). In Italy, the Leonardo Consortium won the bidding process to become the major shareholder of Aeroporti di Roma, which had previously been privatized and is now publicly traded (Airports International, 2000).

The Schipol Group, which controls and operates the Amsterdam Schipol Airport, is currently preparing for an initial public offering of shares on the Amsterdam Stock Exchange. The Dutch government is expected to decide shortly on this matter while the other share holders, the cities of Amsterdam and Rotterdam, already have agreed to sell their respective stakes (Airport World News, 2000). Schipol Group's alliance partner, the Frankfurt Airport Company (FAG), was fully privatized in June 2001 through the initial public offering of its shares. The FAG is anticipated to be part of the consortium operating the new Berlin-Brandenburg Airport in Germany's capital, which will be the first fully privatized airport in Germany after its expected completion in 2007.

Australia has privatized three major airports of Brisbane, Perth and Melbourne. The plan was initiated in July 1997 as the Federal Airport Cooperation offered the sale of long-term leases (Forsyth, 1997). These three airports are Australia's busiest and were sold for a combined AUD 3.337 billion (Cook, 1997). Flughafen Frankfurt/Main AG and its alliance partner, Schipol Group, acquired the long-term lease for the Brisbane airport, the first instance of these two firms working together (Financial Times, 2000). The privatization of the Sydney Kingsford Smith International Airport was completed through the sale of a 99-year lease for AUD 5.6 billion (Airwise News, 2002). Melbourne airport was sold for AUD 1.30 billion to a consortium headed by BAA (Daily Deal, 2002).

Malaysia has begun the process of airport privatization, the first Asian country to do so. Other privatization efforts are under way in various Asian countries; the Omani government is evaluating the privatization of two major airports (Air Finances Journal, 1999).

In Latin America, the Mexican government plans to sell its fast growing Cancun airport on the New York Stock exchange. [5] Grupo Aeroportuario del Sureste SA (Asur), which has been operating the airport as well as eight smaller Mexican airports since early 1998, is expected to retain 15% of the 85% being offered to public, as well as operating control (Wall Street Journal, 2000).

The Santiago International Arturio Benitez Airport in Chile was privatized by a 15-year management concession in early 1999. Argentina awarded a 30-year operating license to a consortium led by US-based Ogden Aviation Group (Ogden Corporation, 1999) for 33 of Argentina's airports.

3.2. United States privatization experience

In the United States, despite the deregulation of its airline industry in 1978, the majority of airports remain under government control. Although concession contracts for certain landside operations (restaurants, parking, etc.) are common, privatization of a few commercial airports has been limited to contract management. More aggressive forms of privatization such as long-term lease and divestiture to the private sector have been avoided as a result of concerns by both commercial and general aviation participants that user fees would increase as a result.

In October of 1995, BAA Plc assumed management control of Indianapolis International Airport (Schwartz, 2000), having promised to increase non-airline revenues by $32 million within the 10-year period for which it signed a management contract. [6] This contract was renegotiated in 1998 and extended until 2008, the longest term allowable under State of Indiana law.

Westchester Airport in New York State has also been privatized by means of management contract. As the airport faced severe losses, the county government decided in 1977 to seek bids for a 5-year management contract. Under contract management, the airport has become solidly profitable with net incomes of up to $3 million per year (Reason Public Policy Institute, 2002).

In October 1996, the US Congress enacted legislation creating the Airport Privatization Pilot Program. This program was established in order to test the effects of privatization of US airports by exempting five airports from the anti-diversion provisions implemented in the Airport and Airway Improvement Act of 1982, allowing them to be privatized (Utt, 1999). The program also eliminated the no-profit rule for the new owner or lessee and the grant-payback requirements (FAA News, 2000).

A major barrier for the participation in the FAA Pilot Program has been the requirement that the city or state obtain the approval of airlines representing 65% of the landed weight at the airport. In the case of many airports, 65% of the landed weight represents a single airline, thus giving the dominant carrier veto power over privatization efforts (Poole, 1999). Few airports have applied for participation in the program, likely in part due to the difficulty in achieving this required airline approval to privatization plans (Utt, 1999).

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[5] It is expected to generate around $400 million of dollars of revenue.

[6] The goal was to achieve a 25% reduction on landing fees by increasing revenues and lowering costs while at the same time improving service quality.

In March 2000, the Federal Aviation Administration (FAA) approved the privatization of Stewart International Airport. Thus, Stewart International Airport became the first US airport to be fully privatized (Reason Public Policy Institute, 2002). Since then, the airport has been operated by National Express Corporation, the US arm of National Express Group, Plc. of England.

The second airport to apply for participation in the pilot project was Niagara Falls International Airport (NFIA) in June 2000. On January 30, 2001, Niagara Frontier Transportation Authority (NFTA), which had been operating the airport under agreement with the US military, reached a 99-year long-term lease agreement with Cintra Concesiones de Infraestructuras de Transporte, SA (NFTA, 2001). However, the FAA ultimately rejected the privatization of NFIA after revised, post-September 11 projections showed the airport would not be profitable for years, sharply reducing or eliminating the investment and airport modernization for which the pilot program had been created (Aviation Daily, 2002). [7]

An application to the pilot program by Brown Field Airport in San Diego, CA remains pending. Under the planned privatization, Diversified Asset Management Group (DAMG), founded in 1994 with a focus on worldwide airport investment opportunities intends to re-develop Brown Field into a cargo port named San Diego Air Commerce Center (SANDACC). Over a 10-year horizon, New York based DAGM plans to invest $1 billion into the project.

3.3. Privatization issues

Airport privatization means the infusion of capital by private sectors to gain partial or total control over an airport's activities and facilities. Private airport owners would be free to charge market prices for their services using rational and market-oriented pricing system to allocate terminals, gates, runways and airspace rather than politically defined mechanisms (Vasigh and Haririan, 2003).

Airport privatization has possible advantages, but also a number of negative concerns. Advocates of airport privatization argue that congestion at airports is due largely to the lack of runway space in busy areas. However, by privatization, congestion at airports would decrease because of realistic prices being charged for services rendered. [8] Proponents also claim that private airport operators are capable of expanding airport infrastructure by increasing investment. [9] Furthermore, the advocates of privatization argue that privatization will generate adequate cash to pay debts, taxes, and render a reasonable rate of return for growth and expansion. [10]

A single owner of multiple airports could reduce costs by taking advantage of economies of scale and scope whenever it owns multiple airports (Semmler, 1996). For instance, the British Airport Authority (BAA) owns and operates the principal airports in Great Britain and engages in aeronautical and non-aeronautical activities. [11] However, the privatization of BAA has not been without its critics. Various groups have argued that by selling BAA's seven airports together, instead of separately, the United Kingdom did not allow for greater competition among the airports.

Airlines and other aviation user groups fear that current federal law may not be able to prevent private operators from using airports as cash mills, taking all of the profit from the airport without investing in the maintenance and improvement of aeronautical facilities (Berry, 1990). Opponents of privatization generally cite London's Heathrow and Toronto's airports as two examples of how privatization can lead to higher charges and lower services (Merliss, 1992, Nauss, 1993). Critics doubt that privatization would help increase the capacity or service. They do believe that privatization would cause private monopolies, and operators would charge consumers as much as possible. In 2001, the public authority that owns Harrisburg International Airport (PA), blamed BAA for a 13.5% drop in passengers since the company took control in January 1998.

To lessen the airlines concern, some countries have imposed some form of price regulation on landing fees. For example, the United Kingdom has capped these fees at historical rates plus an adjustment to account for inflation and increases in productivity. The United Kingdom has also allowed a form of market-based pricing by permitting airports to charge airlines higher landing fees during peak traffic times. The effects of the sale or lease of airports on airline passengers depend on the extent to which increases in airlines' costs would be

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[7] Newburgh Stewart, NY, remains the only airport to be privatized under the FAA program, and is now owned and operated by UK-based National Express Co. The four other slots remain unfilled. Only New Orleans Lakefront Airport's project is still active.

[8] The recent survey of airports by the authors shows that the problem of congestion is only present in some major airports and the majority of smaller airports do not experience any congestion or inadequate runway capacity.

[9] However, there are circumstances where capital is not the constraint, but new facilities just cannot be provided because of physical barriers to expansion, such as absence of suitable land, noise, or environmental considerations.

[10] But there is no empirical evidence to support these speculative claims.

[11] BAA is the world's largest private airport operator. It started as a government agency that ran seven British airports, including London's Heathrow. After it became private in 1986, the company sought airport management contracts around the world, from Italy to Australia.

passed on through higher ticket prices or changes in the number of flights.

4. The theoretical valuation model

Financial theory dictates that the intrinsic, or economic, value of any investment, whether in the form of securities or real assets, is derived from the future cash that such asset is expected to generate. The historic performance of the asset is generally irrelevant to its value today, other than to the extent that such historic performance is indicative of its future performance. Accordingly, measures of asset value such as book value, construction cost, and replacement cost are irrelevant to the economic value. These simply measure either historic cost or investment requirement, not economic value.

Two general methodologies are commonly used to estimate the intrinsic value of a firm. The first is a "direct valuation" approach, which provides an estimate of asset or firm value based upon the cash flows that asset or firm is expected to generate. The second is a "relative valuation" approach in which asset or firm value estimates are obtained by examining the market value of comparable firms or assets. This approach involves applying a market-based multiple to an accounting measure of profit in order to secure a value estimate. [12] This relative valuation approach assumes that the expected cash generation potential of the firm or asset under consider is comparable to that of the asset or firms to which it is being compared.

Financial theory recognizes the superiority of the "direct valuation" approach, commonly referred to as the discounted cash flow (DCF) model. Common variations of DCF include the dividend discount model (DDM) and the residual income model (RIM). These models involve a present value computation of forecasted future cash flows (e.g. dividends, earnings, etc.). Accordingly, these models derive estimated intrinsic value from the economic value to be generated and received by the purchaser of the firm or asset. On the other hand, "relative valuation" methodologies tend to be based upon historical accounting measures, and ignore differences in accounting methodologies and future prospects between the firms.

DCF valuation begins with a forecast of future cash flows to be generated by the firm or asset under consideration. For purposes of valuing an operating entity such as an airport, the appropriate cash flows to consider include not only operating revenues and operating expenses, but also incremental investments or divestitures. Further, operating income should be adjusted for taxes, as well as for non-cash items such as depreciation and amortization. Forecasted operating income is a function of growth from period to period and operating profit margins. Management decisions and policies affect incremental investment or divestiture of fixed and working capital. While the estimations can be complex and require certain assumptions and estimations, periodic cash flow may be simply defined as:

$$CF_t = S_{t-1}(1 + g_t)(p_t)(1 - T_t) - \Delta S(f_t + w_t)$$

where CF is the cash flow applicable to period t; S, sales; g, annual growth rate in sales; p, operating profit margin as a percentage of sales; T, income tax rate; f, incremental fixed capital investment required per dollar of sales increase; w is the incremental working capital investment required per dollar of sales increase.

Each of the future periodic cash flow represents value to be received by the buyer. However, the longer it takes to receive this cash flow, the less valuable it becomes to the buyer today. As such, these future periodic cash flows must be discounted to determine the value of that cash flow to the buyer today. The sum of these discounted future cash flows defines the maximum amount the buyer should be willing to pay for the asset, and thus the value of the asset. In this case the value of an airport can be defined as:

$$V_{\text{Airport}} = \sum_{t=0}^{n} \frac{S_{t-1}(1 + g_t)(p_t)(1 - T_t) - \Delta S(f_t + w_t)}{(1 + k_t)^t}$$

where V_{Airport} is the current or present value of the airport; $k_{\text{Airport},t}$, discount rate applicable to period t; n, the number of periods over which cash flows are expected to be generated; g_t is the expected growth component in period t.

We assume that the overall market rate of return (k_t) will be greater than the expected growth component (g_t).

Clearly, estimating the future periodic cash flows over an extended period of time can be a cumbersome process. Given the indefinite nature of the operational horizon of a firm, future cash flows essentially have an unlimited time horizon. As such, if growth rates are assumed to be constant, along with operating margins and rates of investment, the cash flows represent a constant growth perpetuity, and the value of a firm may be estimated using a variation of the *Gordon Growth* Model: [13]

$$V_t^{\text{firm}} = \frac{CF_{t+1}}{k_t - g}$$

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[12] For example, price-to-earnings, price-to-book, or price-to-sales ratios from the comparable firms.

[13] More complete discussion and derivation of the *Gordon Growth* Model is available in most managerial finance textbooks.

An asset, however, typically has a finite operational horizon, either due to physical limitations or to economic limitations. In such cases, application of the *Gordon Growth Model* would be inappropriate. For these types of assets, the annual cash flow must be estimated and then discounted back to a present value.

In either case, the appropriate discount rate, or required rate of return, must be estimated. This rate reflects prevailing market rates of return adjusted for the risk associated with the investment. In other words, financial theory requires that investments of similar risk, regardless of type of investment, provide similar return. Typically, financial managers estimate the required rate of return on investment projects as a function of the firm's *weighted average cost of capital (WACC)*. Based on the prevailing market returns for the firm's financial securities, the WACC reflects both the prevailing market rates of return, as well as the risk specific to the company. The general formula for the *weighted average cost of capital* is:

$$\text{WACC} = w_d k_d (1 - T) + w_e k_e$$

where w_d is the proportion (weight) of debt funding; k_d, cost of debt; T, corporate tax rate; w_e, proportion (weight) of equity funding; k_e is the cost of equity.

The relevant cost of debt is the interest rate required by investors to earn their desired return given the risk associated with the investment. Computed in this way, the cost of debt (k_d) is expressed by the following formula:

$$k_d = k_{rf} + \text{Debt Premium}$$

where k_{rf} is the risk-free rate; Debt Premium $= \beta_d$ (MRP) + Expected Default Losses + Liquidity Premium; β_d, debt beta; *Market Risk Premium* (MRP) $= k_m - k_{rf}$; k_m is the expected rate of return on the market portfolio.

The debt premium determines the compensation above the risk-free rate that is required by investors for holding the debt. It reflects marketability and exposure to the possibility of default. It also, represents the incremental cost of raising debt. Practically speaking, the cost of debt (k_d) can be determined by calculating the yield to maturity on the firm's outstanding debt issues.

A number of other methods are available to estimate the cost of equity. However, the Capital Asset Pricing Model (CAPM) is the most popular, due to its intuitive appeal and relative ease of application. The CAPM develops a relationship between the non-diversifiable risk of an asset (measured by its beta) and the opportunity cost of investing in that asset. The CAPM links the risk-free rate, the asset's non-diversifiable risk, and the expected return on the market portfolio. The standard CAPM model for return on equity (k_e) is expressed by the following formula:

$$k_e = k_{rf} + \beta_e(\text{MRP})$$

where k_{rf} is the risk-free rate; [14] β_e, equity beta; Market Risk Premium (MRP) $= k_m - k_{rf}$. [15]

Risk relates to the possibility that expected returns may not actually materialize. The total risk of an asset or business is made up of both diversifiable risk and non-diversifiable risk. Diversifiable (or unsystematic) risk is unique to the asset or firm and can be eliminated by diversification.

Using the WACC is an effective means for determining the appropriate required rate of return at which to discount the expected cash flows from an investment, provided however, that the risk of the investment is similar to the average risk of the firm's existing investments. To the extent that the risk of the investment is of greater (or lesser) risk than the firm's average investment, the required rate of return must be adjusted up (or down) accordingly from the WACC. Although a discussion of the methodologies for making this adjustment are outside the scope of this paper, these include risk adjusted cash flow, adding to (or subtracting from) the required rate of return on a educated estimation basis, or estimating the beta specific to the investment by looking to "pure play" firms [16] in the market.

5. Application of valuation model

Three Korean airports were selected with the intention of estimating their value: Gimpo International, Kimhae International and Jeju International airports. These airports are the three largest, in terms of annual traffic volume, among the 16 airports operated by KAC, each with in excess of nine million annual passengers (see Table 1). Prior to March 2001 when IIA commenced operation, Gimpo International Airport had been a primary gateway airport to the Republic of Korea for international traffic. Substantially all scheduled international operations have since moved to IIA,

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[14] The risk-free rate is the interest rate that an investor would earn on a risk-less investment. However, there is no such thing as the risk-free rate in reality. Governments are typically the only entities in the market for funds considered to have such a low level of risk. Therefore, rates for Government bonds are usually used to approximate the risk-free rate.

[15] Market Risk Premium (MRP) represents the additional premium that investors require to hold the market portfolio—a diversified basket of 'risky' assets—over and above the return that can be obtained from investing in risk-free assets. It is not affected by firm specific factors.

[16] A "pure play" firm has operations similar to those of the target firm. In this instance, an appropriate "pure play" firm would have operations limited to airport ownership, and not include other lines of business. Further, this estimated beta must be adjusted for the financial leverage of the "pure play" firm.

while Gimpo has retained the domestic operations. [17] Gimpo had previously operated three passenger terminals and one cargo terminal. Gimpo has since closed two passenger terminals with plans to transform them to general commercial activities (shopping center, wedding hall, cinema, etc.). Traffic volume for Gimpo Airport exceeded 22 million passengers in 2001.

Kimhae International Airport is a main gateway to Busan City, the second largest city in South Korea, located in southeast end of the Korean Peninsula. The population of the Busan Area represents approximately 17% of the total population of the Republic of Korea. Many industries (automobile manufacturing, chemical processing, shipbuilding, etc.) are active in the area.

Jeju International Airport is located on Jeju Island, a popular East Asian resort area. Tourists from China and Japan, as well as Seoul and other major Korean cities represent the majority of passenger traffic. In addition, the central government of the Republic of Korea has designated the Jeju Island as a Free Trade Area. This designation will likely increase both total traffic and business traveler volume through Jeju Airport.

The statistical data used in this research has been provided by the Korea Airports Authority and Korea Aviation Development Association (KADA). Traffic and financial data from three major South Korean Airports are collected from Korea Airports Authority for each year from 1985 to 2001. Results from our work will include valuation of these airports, based on net present value of future net earnings. For benchmarking purposes, passenger and financial data from seven BAA airports was also reviewed.

5.1. Applied discounted cash flow model

Although a valuation based upon the *Gordon Growth Model* would have a theoretical basis, the authors chose to use a 20-year valuation model. Such a terminal model is consistent with general business practices and recognizes the limited life of fixed assets [18] associated with a project finance analysis. Furthermore, as a result of limited financial detail, the authors have elected to use a simplified valuation model, relying on operating income

as a proxy for cash flow. This implicitly assumes that shorter-lived operating assets are replaced as depleted and that such replacement costs incurred are equivalent to the depreciation and amortization charges incurred. Accordingly, the cash flow impacts of these replacements, net of depreciation and amortization, are assumed to be neutral. Replacements of the longer-lived, large-scale assets such as terminals and runways fall outside this analysis and represent incremental investment analyses to be made at the time of replacement. Table 2 highlights the aeronautical revenues, non-aeronautical revenues, and operating expenses of the three airports for 2001.

5.2. Estimated growth rates

Since 1985, these airports have achieved compounded annual growth in revenues of between approximately 13% and 28%. More recently, these growth rates have tempered since 1995 and have averaged between approximately 5% and 18% annually. However, these growth rates are not likely to be sustainable in the long-term.

The ultimate regulatory environment under which these airports as privatized entities would operate can significantly influence the expected growth rates assumed by the potential buyers and the Korean government. This regulatory environment either enables or restricts the potential growth of the airport revenues. For instance, the CAA restricts the ability of BAA to raise or change the fee structure associated with aeronautical revenues. This places increased pressure on BAA to improve revenue generation thru non-aeronautical sources. For the purposes of this analysis and in the absence of specific information to the contrary, the authors make no assumptions regarding the regulatory impact on revenue growth. Likewise, no impact from a more aggressive revenue strategy on the part of the buyer is assumed. As such, growth in the near-term is predicated on recent experience, while long-term growth is driven by projected industry growth.

Both Airbus and Boeing issue bi-annual forecasts of global aviation markets, which are used to estimate demand for commercial aircraft. These forecasts provide

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[17] This structure is similar to that in use in Tokyo where Narita serves international operations and Haneda serves domestic operations.

[18] Airports employ a variety of fixed assets with varying physical lives, from 4 years up to 50 years or more. The 20-year assumption of the model recognizes (i) an implicit average of these differing lives, (ii) that the economic life may differ substantially from the physical life for the longer-lived assets, and (iii) the present value of benefits to be received beyond 20 years diminishes rapidly. For instance, $1000 received in 50 years represents only $16.92 in value today at an 8.5% discount rate.

Table 2
2001 operating revenues and expenses

	(Millions won)		
	Gimpo	Kimhae	Jeju
Aeronautical revenues	67,340.3	22,734.8	12,293.4
Non-aeronautical revenues	54,305.3	28,755.4	13,140.3
Total revenues	121,645.6	51,490.2	25,433.7
Total operating expenses	108,826.7	24,731.9	29,782.8
Net revenue	12,818.9	26,758.3	−4349.1

significant insight into expected growth trends in commercial aviation over a 20-year horizon. While the approaches taken by, and the perspectives of the two firms differ, the results with respect to passenger growth are comparable. In its most recent report, Airbus (2001) forecasts growth in RPK of 5.1% in the Asian market, while Boeing (2003) forecasts RPK growth of 5.7% in the Northeast Asian market. Both companies anticipate that portions of this growth will be accomplished through larger size aircraft. Among other considerations, the resulting fleet growth will fall between 4.1% (Airbus) and 5.1% (Boeing). Additionally, Airbus (2001) forecasts growth in worldwide departures of 3.2% against worldwide RPK growth of 4.7%. Extrapolating this forecast of departure growth rates implies a 3.7% annual growth rate in departures for the Asian region.

For purposes of this valuation analysis, the authors have assumed that the compounded annual growth rates in operating revenues and expenses recently achieved by the three airports will continue for the near-term, in this case 5 years. Subsequently, the authors use the average forecasted rate of fleet growth as the proxy for growth in aeronautical revenues, the average forecasted rate of RPK growth as the proxy for growth in non-aeronautical revenues, and the extrapolated growth for departures for the Asian region as the proxy for operating expense growth. These growth rates are summarized in Table 3.

Doganis (1992) estimated that airports realized increasing economies of scale up to approximately 3.0 million passengers at which point economies of scale flattened with stabilized unit cost. In such a situation, growth in operating expenses equals growth in unit volume. The authors use the growth in departures for the Asian region as the proxy for unit growth, and thus operating expense growth. While not specifically addressing growth in Korean aviation activity, the growth rates in the Asian region provide a more meaningful measure of activity growth for Korea than using a global growth rate would.

5.3. Estimated discount rate

As a point of reference, IIA has financed 60% of its construction costs with debt averaging 8.5% (Hannon, 2001). As a government entity, the tax benefit of debt does not necessarily apply. While a private entity may enjoy a lower cost of debt due to its tax deductibility, its cost of equity would likely be higher. Furthermore, England's Civil Aviation Authority (CAA) recently recommended a WACC of 8.5% for BAA's construction of Heathrow's new Terminal 5 (Competition Commission, 2002). [19] As such, the authors chose 8.5% as the relevant cost of capital to use for estimating the value of the Korean airports. Table 4 provides a summary of historical airport transactions for comparative purposes.

6. Results

Based upon the above application of the DCF model, the authors estimate a preliminary aggregate value of $1.8 billion for the three Korean Airports under consideration, as highlighted in Table 5. While Gimpo has an estimated value of $1.2 billion, Jeju is estimated to have a value of only $1.5 million. This significant difference in value is driven by the operating performance of the two airports. As highlighted in Tables 2 and 3, Gimpo generated positive operating income in 2001 while Jeju incurred an operating deficit. Further, Gimpo is estimated to enjoy more aggressive short-term growth than either Jeju or Kimhae creating greater value for that airport. Based upon the model assumptions, Jeju is forecasted to incur operating losses through 2009, depressing the value of the airport. This obviously creates an opportunity for a commercial operator, which may rationalize the cost structure of Jeju and increase revenues more aggressively, thereby, improving the value of the airport from that estimated herein.

It must be noted that these values provide one estimate of the intrinsic value of these airports. This does not necessarily represent the price that can or should be achieved in a sale of the airports. While the concepts of value and price are related, they are not in fact the same. As discussed above, value is a function of the expected future cash flows to be generated. Accordingly, the value of an asset can and does fluctuate over time as expectations change. Furthermore, these expectations, particularly for a project as complex as an airport, likely differ between individual buyers and sellers.

While price is a function of value, it also reflects the dynamics of the sale process and included a

Table 3
Estimated growth rates for Gimpo, Kimhae and Jeju airports

	Short-term growth rates		
	Gimpo	Kimhae	Jeju
Aeronautical revenues (%)	20.0	16.1	11.5
Non-aeronautical revenues (%)	15.6	9.5	11.0
Total operating expenses (%)	5.9	4.7	8.8
	Long-term growth rates		
Aeronautical revenues (%)	4.6	4.6	4.6
Non-aeronautical revenues (%)	5.4	5.4	5.4
Total operating expenses (%)	3.7	3.7	3.7

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[19] Competition Commission (2002) discusses a broad range of estimates of WACC for BAA, highlighting the in-exact nature of determining WACC.

Table 4
Historical airport transaction values

Airport	Purchaser	Percentage purchased	Sales date	PAX (in millions)	PP (million US$)	PPAX
Birmingham, UK	Aer Rianta	40%	Mar-97	2.7	$58	$21.48
Bolivia (three airports)[a]	AGI (TGI PLC)	N/A	Mar-97	1.2	N/A	N/A
Brisbane, Australia	Schipol	100%	Jul-97	5.1	$1100	$215.69
Melbourne, Australia	BAA	100%	Jul-97	6.7	$1100	$164.18
Perth, Australia	AGI (TGI PLC)	100%	Jul-97	2.2	$495	$225.00
Rome, Italy	Public Flotation	45%	Jul-97	11.9	$344	$28.91
Naples, Italy	BAA	70%	Aug-97	1.5	$32	$21.33
Duesseldorf, Germany	Hochtief/Aer Rianta	50%	Jan-98	7.5	$208	$27.73
Argentina[b]	Ogden/SEA Milan	100%	Feb-98	7.8	$1400	$179.49
South Africa	Aeroporti di Roma	20%	Mar-98	8.1	$165	$20.37
Adelaide, Australia	Manchester	100%	Mar-98	1.8	$238	$132.22
Coolangata, Australia	Manchester	100%	Mar-98	1	$70	$70.00
Canberra, Australia	Local Consortium	100%	Mar-98	0.9	$44	$48.89
Hobart, Australia	AGI (TGI PLC)	100%	Mar-98	0.5	$24	$48.00
Launceston, Australia	BAA	100%	Mar-98	0.3	$11	$36.67
Auckland, New Zealand	Public Floatation	52%	Jul-98	3.4	$232	$68.24
Wellington, New Zealand	Infratil	66%	Aug-98	1.6	$49	$30.63
Mexico[c]	Copenhagen	15%	Nov-98	4.7	$116	$24.68
Malaysia Airports Holdings[d]	Public offering	28.00%	Nov-99	32.7	$130	$3.98
Stewart International, USA[e]	National Express	100.00%	Sep-00	0.3	$35	$116.67
Hamburg International, Germany	Hochtief/Aer Rianta	36.00%	Oct-00	9.5	$256	$26.95
Athens Intl. Airport S.A, Greece[f]	Hochtief/Aer R./Fraport	45.00%	Mar-03	N/A	$1833	N/A
Lima Jorge Chavez Intl, Peru	FRAport/Bechtel/Cosapi	42.80%	Feb-01	2.2	$6.49	$2.91
Sydney Kingsford Smith, Australia	Southern Cross Airport Corp.	100%	Jun-02	23.9	$3180	$133.05

[a] La Paz, Santa Cruz, and Cochabamba were offered for a 25-year concession with annual payments to be made. AGI bid 20.8% of gross revenues.
[b] 30-year concession for 33 airports. The purchase price is based upon the present value of guaranteed Annual rent payments of $171.1million.
[c] 50-year concession for nine airports in the south east (including Cancun).
[d] MAHB has a 30-year management contract for 36 of Malaysia's airports, as well as a 50-year lease Agreement for Kuala Lumpur International Airport.
[e] 99-year lease contract under the FAA pilot privatization program.
[f] 30-year concession under a BOT scheme.

Table 5
Estimated value for Gimpo, Kimhae and Jeju airports

	Value (millions US$)[a]
Gimpo	$1196.0
Kimhae	$572.0
Jeju	$1.5

[a] Based upon an exchange rate of 1185 as of January 23, 2004.

rationalization these differing expectations. In a perfectly competitive market such as a stock exchange, these differences are efficiently rationalized to achieve a market price. However, the sale of an airport, or any firm, occurs in an imperfect market where such differences must be negotiated between the buyer and the seller, resulting in a price that likely differs from both party's estimate of value.

In fact, both parties are likely to have a range of values based upon various assumptions. For instance, in the case of the three Korean airports discussed herein, the buyer may make assumptions of accelerated growth

in non-aeronautical revenues resulting from the implementation of new strategies, as was achieved by BAA. However, the incremental value associated with this accelerated growth represents the value-added of the buyer (not necessarily of the airport as it operates today) and an opportunity for the buyer. Thus, the buyer would have a high-end value based upon this accelerated growth and a low-end value based upon the nominal growth rate suggested above. The buyer would likely to strive to pay the low-end value, would not pay more than the high-end value, and would likely be required to pay something in between.

Furthermore, since the required rate of return is adjusted for risk, it necessarily tied to general market trends in interest rates. These trends are impacted by many factors including inflation rates and macro-economic dynamics. Accordingly, the required rate of return shifts over time, not only in connection with changes in the *relative* risk of operating an airport, but also with changes in general market rates. As highlighted in Table 6, the aggregate intrinsic value

Table 6
Discount rate sensitivity of values for Gimpo, Kimhae and Jeju airports

	Discount rate		
	8.0%	8.5%	9.0%
Value (millions US$)[a]			
Gimpo	$1257.3	$1196.0	$1138.5
Kimhae	$599.4	$572.0	$546.3
Jeju	$2.4	$1.5	$0.7

[a] Based upon an exchange rate of 1185 as of January 23, 2004.

Table 7
Growth rate sensitivity of values for Gimpo, Kimhae and Jeju airports

	Change in long-term growth		
	−1.0%	+0.0%	+1.0%
Value (millions US$)[a]			
Gimpo	$1130.5	$1196.0	$1267.3
Kimhae	$543.2	$572.0	$603.4
Jeju	$0.3	$1.5	$2.8

[a] Based upon an exchange rate of 1185 as of January 23, 2004.

estimated herein increases/(decreases) by $90.0/(83.9) million with a 0.5% decrease/(increase) in the discount rate used.

Similarly, changes in the assumed growth rates impact the estimated aggregate value of these three airports. A 1% increase in all long-term growth rates results in a $104.0 million increase in estimated value, while a 1% decline in all growth rates results in a $95.5 million decrease in estimated value (see Table 7). While growth in aeronautical and non-aeronautical revenues depends on many exogenous factors, expense growth is more directly in the control of management. If operating expense growth in the long-term is 1% slower than originally forecast and revenue growth remains unchanged, an additional $87.6 million of estimated value results (see Table 8).

Finally, the regulatory environment under which these airports were to be privatized has a potentially significant impact on their intrinsic value. The level of regulatory constraints on rates and fees necessarily impacts expectations of the future cash flows to be gener-

Table 8
Differential growth rate sensitivity of values for Gimpo, Kimhae and Jeju airports

	Change in long-term expense growth		
	−1.0%	+0.0%	+1.0%
Value (millions US$)[a]			
Gimpo	$1253.2	$1196.0	$1133.7
Kimhae	$584.3	$572.0	$558.6
Jeju	$19.5	$1.5	$18.1

[a] Based upon an exchange rate of 1185 as of January 23, 2004.

ated. Further, the regulatory environment also influences the perceived business risk, reducing or increasing the present value of these expected future cash flows, and thus the intrinsic value.

7. Conclusion

The authors estimate the combined value of Gimpo International, Kimhae International, and Jeju International airports at approximately $1.8 billion. This estimated value provides a benchmark against which to evaluate the ultimate price achieved for the airports. The value of these airports to any private investor, and thus the price such an investor is willing to pay, depends on many issues that must be considered prior to purchase. Moreover, expectations are likely to differ substantially among various buyers and with the seller. Therefore, the ultimate price achieved depends not only on these expectations at the time of sale, but on the dynamics of negotiating the differences in expectations between the seller and the various buyers, as well as the goals the Korean government would seek to achieve through privatization. [20] The valuation model used by the authors assumes near-term operating performance to be consistent with recent experience. No value is attributed to accelerated near-term growth or improved operating margins, which may result from strategies and policies implemented by a commercial operator. A private investor, however, is likely to expect potentially significant improvements in operating margins and accelerated near-term growth in operating cash flow. These improvements are likely to result in a substantially higher valuation than presented herein.

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[20] The British government was less concerned with the price achieved than with the completion of the privatization process of its airports.

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