Privatization, Corporatization, Ownership Forms and their Effects on the Performance of the World's Major Airports

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Abstract

This paper investigates the effects of ownership forms and management structure on the performance of airports around the world. Specifically, we focus on measuring and comparing productive efficiency and profitability among airports owned and operated by government departments, 100% government-owned corporations, independent airport authorities, mixed enterprises with government majority ownership and mixed enterprises with private majority ownership. The key results of our analysis based on an extensive cross-sectional, time-series dataset (2001-2003) for the major Asia-Pacific, European and North American airports are: (1) there is strong evidence that airports with government majority ownership and those owned by multi-level of government are significantly less efficient than airports with a private majority ownership; (2) there is no statistically significant evidence to suggest that airports owned and operated by U.S. government branches, independent airport authorities in North America., or airports elsewhere operated by 100% government corporations have lower operating efficiency than airports with a private majority ownership; (3) airports with a private majority ownership achieve significantly higher operating profit margins than other airports; whereas airports with government majority ownership or multi-level government ownership have the lowest operating profit margin; (4) on average, airports with a private majority ownership derive a much higher proportion (56%) of their total revenue from non-aviation services than any other category of airports while offering significantly lower aeronautical charges than airports in other ownership categories excluding U.S. airports. Our results suggest that private-public-partnership with minority private sector participation and multi-level governments' ownership should be avoided, supporting the majority private sector ownership and operation of airports.

Keywords: privatization; ownership forms; airports; efficiency; profitability.

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1. Introduction

Historically, airports around the world were owned and operated by governments. Since the mid-1980s, however, significant changes have occurred in the way airports are owned, managed, and operated. With the exception of the United States,[2] corporatization, commercialization and privatization of airports have become the worldwide trend. The motives for ownership and institutional restructuring via commercialization and privatization are diverse, but normally include easier access to private sector financing and investment, and improved operational efficiency. The commercialization and privatization have taken different formats/models in different countries. For example, in 1987 the U.K. government sold its seven major airports including three airports in the London area (Heathrow, Gatwick and Stansted) to British Airports Authority (BAA plc), a 100% private sector firm. Since then, many airports around the world have been or are in the process of being privatized or commercialized, including most of the major Australian airports. Majority stakes in Copenhagen Kastrup Airport, Vienna International Airport, and Rome's Leonardo Da Vinci Airport have been sold to private owners. Many other European airports are in the process of being privatized. In New Zealand, major national airports including Auckland and Wellington International Airports are operated by 'for-profit' private sector firms with various local governments as minority owners.[3] It is interesting to note that New Zealand did not introduce any formal form of price regulation with regard to the privatized airports, whereas most of the major Australian airports were privatized utilizing price-cap regulation up until June 2002 (Productivity Commission, 2002).[4] South Africa, Argentina, Mexico, Japan and many other Asian countries are also in the process of privatizing their airports.[5] In Canada, the federal government has retained ownership of its major national airports, but these airports are managed and operated by locally-

[2] Contrary to the worldwide trend, airports in the United States have remained mostly government-owned and operated. However, the government ownership and operation of US airports are considered to be rather different from those of other countries in that there is substantial private sector involvement in management decisions concerning key airport activities and capital investment decisions. For example, because most of the major capacity expansion projects are financed through revenue bonds guaranteed by the major tenant airlines, these airlines have substantial power over airports' decisions on capacity investment, user charges, and other key strategic decisions. Since these U.S. airlines face a very competitive market place, they act as a pressure group, continually requiring U.S. airports to improve operational efficiency (Bailey, 2002; Carney and Mew, 2003).

[3] There are some notable exceptions however. For example, the City of Christchurch, through Christchurch City Holdings, owns 75% of Christchurch International Airport. The City maintains an arms length relationship with the airport, giving the airport considerable autonomy in its operation and management

[4] Except for Sydney airport, price regulation was in place in the form of a CPI-X price-cap on declared aeronautical services. At Sydney airport, aeronautical services are subject to price surveillance, administered by the Australian Competition and Consumer Commission. The price regulation of most privately owned airports was removed in July 2002.

[5] See Hooper (2002) for the list of Asian airports that are being considered for privatization.

based airport authorities, which are incorporated as 'not-for-profit non-share capital corporations' with long term leases.

This paper examines how various ownership forms and institutional structures affect the performance of airports in terms of their productive efficiency, operating profits and user charges. In Section 2, we summarize the literature on privatization, ownership forms and firm performance. The general framework of our analysis for measuring the efficiency and profitability effects of airport ownership form and governance structure is presented in Section 3. The data sources, sample airport characteristics and details on variable construction are given in Section 4. Section 5 presents empirical results and a discussion of the findings. Finally, Section 6 presents a summary, conclusions and further research needs.

2. Literature on Privatization, Ownership and Firm Performance

The effects of ownership on firms' productive efficiency have been an important research topic in both the economic and management literatures. The agency theory and strategic management literature suggest that ownership influences firm performance because different owners pursue distinctive goals and possess diverse incentives. Under government ownership, a firm is run by bureaucrats who maximize an objective function that is a weighted average of social welfare and his/her personal agenda. Under private ownership, by contrast, the firm is run for the maximization of profit (shareholder value). A common-sense view is that government-owned firms are less productively efficient than their private sector counterparts operating in similar situations. The main arguments supporting this view are: (1) the objectives given to the managers of government owned firms are vaguely defined, and tend to change as the political situation and relative strengths of different interest groups change (Levy, 1987; De Alessi, 1983; Backx et al., 2002); (2) "the diffuseness and non-transferability of ownership, the absence of a share price, and indeed the generic difficulty residual claimants would have in expressing 'voice' (much less choosing 'exit'), all tend to magnify the agency losses" (Zeckhauser and Horn, 1989).

Neither empirical nor theoretical evidence presented in the vast management and economics literature is conclusive with respects to the above view despite its general acceptance in the popular press. De Fraja (1993) questioned the logic of the main arguments, and showed, through a principal-

agent model, that government ownership "is not only not necessarily less productively efficient, but in some circumstances more productively efficient". Vickers and Yarrow (1991) suggest that private ownership has efficiency advantages in competitive conditions, but not necessarily in the presence of market power. They further suggest that even under competitive market conditions, government ownership is not inherently less efficient than private ownership, and that competition is the key to efficiency rather than ownership per se; in markets with monopoly elements, the major factor that appears to be at work is regulatory policy.

There are a number of surveys of empirical studies on efficiency that compare private and government owned firms. The results are far from conclusive. For example, De Alessi (1980) and Bennett and Johnson (1980) provided rather strong evidence for the view that private firms would perform better than government owned firms, whereas Millward and Parker (1983) found that "there is no systematic evidence that public enterprise are less cost effective than private firms", Boyd (1986) agrees with this finding.

Further complicating the ownership-performance debate is the presence of a mixed ownership regime embodying elements of government and private ownership. Bos (1991) provides an excellent theoretical discussion on the behavior of mixed ownership firms. On one hand, mixed ownership may facilitate the role of the government as a "steward" in private firms that are dominated by a strategic investor or where there is a lack of market discipline. On the other hand, mixed ownership arrangements may blend the worst qualities of government and private ownership. Thus, the resulting effects of mixed ownership on firm performance are not clear from a theoretical perspective. Empirical evidence is limited, and thus fails to provide any clarification on the issue. Boardman and Vining (1989) found that mixed ownership perform no better and often worse than government owned firms, which may be caused by the conflict between public and private shareholders. Their finding is supported by the analytical and empirical productivity growth investigations of Ehrlich et al. (1994). On the other hand, Backx, Carney and Gedajlovic (2002) found that airlines with mixed ownership tend to perform better than government owned airlines.

The lack of consensus on the ownership-performance issue is not surprising because public versus private firms' performance may depend on management and institutional arrangements as well as the market and competition conditions in which the firms operate. The literature in corporate

governance suggests that different ownership arrangements embody distinct patterns of authority, responsibility and economic incentives that influence the quality of managerial performance (Charkham, 1996). For example, in the airport industry, major airports in Canada are owned by the federal government but operated by commercially oriented local airport authorities under long term lease agreements. Would one expect such airports to behave in a similar manner to those owned and operated by a government agency, such as the airports operated by the Swedish Civil Aviation Administration? Similarly, under the broad umbrella of private ownership, some firms are controlled by dominant shareholders whereas others have very diffused ownership and are controlled effectively by managers. The important question here would be who actually controls the firm and thus influences its performance (Gorriz and Fumas, 1996).

Many studies have examined the performance of airports using different methodologies. For example, Hooper and Hensher (1997) examined the performance of six Australian airports over a 4-year period using the total factor productivity (TFP) method. Gillen and Lall (1997) developed two separate data envelopment analysis (DEA) models to evaluate terminal and airside operations independently from each other, and applied them to a pooled data of 21 top U.S. airports for the 1989-93 period. Nyshadham and Rao (2000) evaluated the efficiency of European airports using TFP and examined the relationship between the TFP index and several partial measures of airport performance. Sarkis (2000) evaluated the operational efficiency of U.S. airports and reached the tentative conclusion that major hub airports are more efficient than spoke airports. Adler and Berechman (2001) used DEA to analyze airport quality and performance from the airlines' viewpoint. Martin and Roman (2001) and Martin-Cejas (2002) applied DEA and translog cost functions, respectively, to evaluate the performance of Spanish airports. Abbott and Wu (2002) investigated the efficiency and productivity of 12 Australian airports for the period 1990-2000 using a Malmquist TFP index and DEA.

Despite the diversity of airport ownership structures and management arrangements, the aforementioned studies with the exception of Parker (1999)[6], have largely ignored the effects of institutional factors on airports' productivity and efficiency. Advani and Borins (2001) investigated how airport service quality is affected by ownership status, privatization-anticipation, competition,

[6] Using Total Factor Productivity analysis, Parker (1999) found that BAA privatization had no noticeable impact on airport technical efficiency while Yokomi (2005) using Malmquist TFP index method found that almost all airports under BAA Plc. have improved technical efficiency after privatization.

and a number of other factors. Using data from a questionnaire survey of 201 airports across the globe, the study found that private airports tend to provide better services. Airola and Craig (2001) appear to be the only study that explicitly examined the effects of airports' governance on efficiency performance. Based on a sample of 51 US airports, they distinguished two types of airport governance structures: city operated airports versus airport authority operated airports. Their results suggest that the authority-operated U.S. airports out-performed city-operated U.S. airports in terms of technical efficiency. It is noted, however, that their study uses only one output measure (number of aircraft movements) in measuring efficiency. As articulated in Oum, Yu and Fu (2003), the omission of other outputs such as commercial services is likely to bias efficiency results as it underestimates productivity of the airports with proactive managers who focus on exploiting the revenue generation opportunities from non-aviation (including commercial) business.

Airport ownership/governance models can be classified into: (a) government agency or department operating an airport directly; (b) mixed private-government ownership with a private majority; (c) mixed government-private ownership with a government majority ; (d) government ownership but contracted out to a management authority under a long term lease; (e) multi-level governments form an authority to own/operate one or more airports in the region; (e) 100% government corporation ownership/operation. Since most of the previous studies have used specific continental or country-specific airport data, rather than relying on the worldwide privatization experiences and have not attempted to distinguish economic performance among the six categories of airport ownership/governance categories, this paper introduces a new analysis to the existing empirical literature. Furthermore, among the limited studies that attempted to measure the difference between privatized airports (without distinguishing the extent of privatization) and the publicly owned/operated airports, there is no consensus in their findings. Finally, almost all of the studies used a partial measure of outputs (aircraft movements and/or passengers/cargo traffic only) ignoring non-aviation service outputs (including commercial services such as concessions) that all airports produce. Given that non-aviation outputs can account for as much as 70 % of total revenues an airport generates, the productivity measures ignoring the non-aviation service outputs would be seriously biased against airports that generate a high proportion of their total revenues from commercial services.

3. Model Formulation

In order to test the hypotheses concerning varying degrees of privatization, other ownership forms and governance structures on the performance of airports, we propose the following framework of analysis. We will study productivity levels as a function of:

- Ownership and Governance Form
- Management Strategy Variables
- Airport Characteristics and Business Environment
- Technical (residual) efficiency

A Variable Factor Productivity (VFP) measure will be developed to measure the level of productivity. VFP is simply the ratio of total aggregate output over aggregate variable input. Variable inputs include labor, purchased goods and materials and purchased services including outsourcing/contracting out. VFP is used as the airport performance indicator in this research for several reasons. First, it is nearly impossible to obtain consistent capital input measures comparable across airports due to the different ownership and governance structures. Second, there is no standardized accounting or reporting system across airports worldwide. Third, airport capacity expansion and other capital projects are often subsidized to varying degrees at various levels of government, which would distort the measurement of total factor productivity (TFP). On the other hand, data on variable input factors can be compiled with reasonable accuracy. In addition, long term investment decisions with regard to capacity expansion are generally beyond airport managerial control, even at private airports[7].

Ownership/Governance Variables: As discussed in section 2, each airport in our sample is classified into one of the following six ownership/governance types:

(a) government agency or department operating an airport;

(b) mixed private-government ownership with private sector owning a majority share;

(c) mixed government-private ownership with government owning a majority share;

(d) government ownership but contracted out to an airport authority under a long term lease;

(e) multi-level governments form an authority to own/operate airports in the region;

(e) 100% government corporation ownership/operation;

[7] For example, BAA still needs approval from the British government for major capital projects, despite the fact that it is a purely private sector enterprise.

Table 1 provides a list of airports included in the sample and their ownership and governance structure. A closer examination of the airport authorities/administrations operating outside North America indicates that they operate in a manner similar to government corporations, rather different from the airport authorities in North America. Therefore, we re-classified the airport authorities/administrations in Asia and Europe into the group of government corporation.

Management Strategy variables describe an airport's management and operational strategies. Some airports focus on the traditional airport business, thus derive most of their revenue from aeronautical activities. Others have vigorously expanded into the commercial business sector. In this research, the share of non-aeronautical revenue out of total airport revenue is used as an indicator of the degree of airport business diversification.

Airport Characteristics affecting productivity performance include:

- airport size (scale of output);
- average size of aircraft using the airport;
- composition of airport traffic,
- extent of capacity constraint;

Airport size is represented by an aggregate output index as constructed in the ATRS global airport benchmarking reports (2003, 2004 and 2005). Airport size can vary significantly only in the very long run, through managerial design and effort. Since managers cannot alter the airport size variable significantly in the medium and short run, we regard the effect of airport size as being beyond managerial control. Average aircraft size is measured by the average number of passengers per aircraft movement and is dependent on the length of the runway(s), geographical location of the airports (intercontinental gateway airports tend to handle larger aircraft) etc. The composition of airport traffic is measured by the percentage of international traffic and the percentage of cargo traffic, both of which depend largely on the geographic location of the airport. Capacity constraints exist both with respect to runway and terminal capacity and are imposed by regulatory, environmental and investment funding concerns. They are generally beyond managerial control, however runway and terminal capacity shortages affect productivity and quality of service to users of airport services, resulting in delays and inconvenience to airlines, passengers and shippers. Finally, service quality is another factor that may

affect airport performance, a preliminary investigation by ATRS (2003) did not indicate any significant effect on the VFP, and thus was excluded from the present study.

4. Sample Airports and Variable Construction

4.1 Sources of Data and Construction of Variables

Our sample includes up to 116 airports as listed in Table 1. These airports represent different sizes and ownership and governance structures. . The data is compiled from various sources including the International Civil Aviation Organization (ICAO), Airport Council International (ACI), the U.S. Federal Aviation Authority (FAA), International Air Transport Association (IATA), airport annual reports and direct communication with airports. Details on the data are provided in the ATRS Global Airport Benchmarking Report (2003, 2004, 2005).

To measure the Variable Factor Productivity (VFP), one must first identify outputs that an airport produces and the inputs it uses in producing these outputs. The most commonly used output measures for airports are the number of passengers, the volume of air cargo, and the number of aircraft movements. Airports typically impose direct (separate) charges for their services related to aircraft movements and the handling of passengers. However, air cargo services are generally handled by airlines, third party cargo handling companies, and others that lease space and facilities from airports. Air cargo services are not considered as a separate output in this research, as airports derive a very small percentage of their income from direct services related to air cargo. In addition to passenger traffic, cargo traffic and aircraft movements, airports also derive revenues from concessions, car parking, and numerous other services. These services are not directly related to aeronautical activities in a traditional sense, but they are becoming increasingly more important for airports around the world and account for over 60% of the total revenues for many airports such as Brisbane, Tampa, Munich, etc. Thus, we consider a third output that consists of revenues from non-aeronautical services. A non-aeronautical output index is constructed by deflating the non-aeronautical revenues by Purchasing Power Parity (PPP). For most airports, aeronautical and non-aviation inputs are not separable, thus any productivity or efficiency measure computed without including the non-aviation service output would lead to severely biased results. Inclusion of the non-aeronautical services output not only removes such bias in productivity measurement, but also

allows us to examine the efficiency implications of airport business diversification strategies. An overall output index is constructed by aggregating the three output measures (passengers, aircraft movement and non-aeronautical output) using the widely accepted translog multilateral index procedure developed by Caves, Christensen, and Diewert (1982).

On the input side, we initially considered three variable input categories: (1) labor, measured by the number of employees (full time equivalent) who work directly for an airport operator; (2) purchased goods and materials; and (3) purchased services including outsourcing/contracting out. In practice, however, few airports provide separate expense accounts for the purchased (outsourced) services and purchased goods and materials. Thus, we decided to combine (2) and (3) to form a so-called 'soft cost' input. The soft cost input includes all expenses not directly related to capital or labor input costs. As the soft-cost input is measured in monetary terms, and airports operate in countries with very different price levels, purchasing power parity (PPP) is used as a deflator to derive a consistent soft cost input index.. Exclusion of the soft cost input would bias productivity comparisons significantly in favor of the airports that outsource much of their services such as passenger terminal operations, ground handling services, fire fighting, police and security services, etc. A variable input index is constructed by aggregating labour and soft cost input using the CCD index procedure.

Variable Factor Productivity (VFP) is defined as the ratio of the aggregate output index over the variable input index. VFP measures how productively an airport utilizes variable inputs in producing outputs for a given level of capital infrastructure and facilities.

4.2 Characteristics of Some Sample Airports

Table 2 provides some interesting statistics for selected sample airports.[8] These statistics indicate that there are large variations among the sample airports in terms of their size, business and operating environment. For example, the annual number of airport passengers ranges from 2.3 million passengers for Penang (Malaysia) to 79 million passengers for Hartsfield-Jackson Atlanta International Airport (United States) in 2003. Some airports serve mostly international traffic, such as Amsterdam, Brussels, Singapore, and Hong Kong, whereas others serve mostly domestic passengers, such as Kansas City where international traffic accounts for less than 1% of their total passenger traffic in 2003. Some

[8] Due to space limitations, not all sample airports are listed.

airports provide services mostly to large aircraft, whereas others serve many small aircraft. For example, the average number of passengers per aircraft movement was 156 passengers at Narita and Kansai in 2003, but only 36 passengers per aircraft at Raleigh-Durham in the same year. Some airports derive most of their revenue from aeronautical activities, whereas for others, a significant portion of revenue comes from other sources including concession, car-parks and rentals. For example, in 2003, aeronautical revenue accounts for 73% of New York JFK's total revenue, while it is only 32 % of total revenue at Brisbane (Australia). Hub carrier's market share (in terms of frequency) varies across airports as indicated in the last column of Table 2. Oum, Yu and Fu (2003) show that some of these factors are statistically significant in explaining variations in productive efficiency among the airports, yet they are beyond managerial control. Therefore, it is important to control for the effects of these variables when testing hypotheses concerning the effects of ownership and governance structure of the airports.

5. Empirical Results and Discussion

A series of regression analyses were conducted to examine the effects of ownership forms and other variables on airport productivity performance. Since the business environments within which these airports operate are very different across Asia, Oceania, Europe and North America, we decided to include continental dummy variables in our VFP regression models with North America as the benchmark. The private majority ownership is used as the base in all regressions. The regression results for three different sets of variables are reported in Table 3, and the results are discussed in the following sections.

5.1 The Effects of Regional Business Environments

The regression coefficients on the regional dummy variables indicate that the overall business environments in Asia and Europe appear to have negative influences on the operating efficiency of their airports, whereas the open business systems in Australia and New Zealand appear to help enhance airports' operating efficiency, as compared to the North American airports.

5.2 The Effects of Ownership Forms

The coefficient for airports owned/operated by city/state government departments in the U.S. is not statistically significant in any of the 3 models, indicating that there is no significant difference in operating efficiency performance between these U.S. airports and those with a private majority ownership. This result provides some evidence supporting the claim by de Neufville (1999) and Dillingham (1996) that the U.S. airports are among the most "privatized" in the world, as U.S. airports routinely turn to airlines for financial help in facility expansion and modernization and in return offer long-term leases that often give airlines strategic control of airports through majority-in-interest (MII) arrangements. Since U.S. carriers face a very competitive market place, they act as a pressure group continually requiring airports to improve efficiency (see Bailey, 2002; Carney and Mew, 2003). Furthermore, private companies (airlines, concessionaires and contractors) deliver most of the airports' day-to-day operations and services. In fact, the government body that owns a US airport often employs only about 10 to 20% of the workforce active at the airport (de Neufville, 1999).

Similarly, the coefficient for the (North American) airport authority is also not statistically significant in any of the regressions, indicating that there is no significant difference in productive efficiency between airports operated by airport authorities and those with a private majority. The airport authorities in North America appear to have sufficient freedom to operate airports in a business-like manner. Under these circumstances, ownership does not always reflect how an airport is operated.9 This result also indicates that there is no significant efficiency difference between airports operated by North American authorities and airports owned/operated by U.S. government branches. This finding disputes those of Airola Craig (2001) who found that the authority-operated U.S. airports out-performed city-operated airports in terms of technical efficiency. It is noted, however, that their study used only one output measure, aircraft movements, as discussed in the literature review section.

The coefficient for airports with a government majority is negative and statistically significant, indicating that airports with government majority are about one third less efficient than the airports with a private majority. Partial privatization that gives private sector a minority interest does not appear to work well in terms of improving operating

[9] Results from a separate set of regressions with US airports operated by city/state department as base indicate that there is no significant difference in productive performance between the airports operated by airport authorities in North America and those operated by city/state department.

efficiency. This result is consistent with the empirical findings of Boardman and Vining (1989) in other industries, and the theoretical and empirical results of Ehrlich et al (1994) as discussed in the literature review section.

The dummy variable for airports with shared ownership by multiple governments has a statistically significant negative coefficient in all of the regression models in Table 3, indicating that involvement by multiple governments is likely to lead to inefficiency in airport operation. It appears that this type of airport ownership is significantly less efficient than the airports under a majority private ownership, as multiple government owners attempt to influence airport management with conflicting objectives.

The dummy variable for Government (Public) Corporation is not statistically significant. This indicates that there may not be significant differences between airports operated by a corporation under a single government ownership and those with a private majority ownership, once the differential operating environments within which these airports operate are controlled. Millward and Parker (1983) and Boyd (1986) found essentially the same results.

The most surprising result with respect to ownership is that 100% public (single government owned) airports are more efficient than the PPP (Public Private Partnership) airports, when a government has a majority ownership and control. Given that the airports operated by 100% government-owned corporations are almost as efficient as the airports with either 100% or a majority ownership in the private sector (i.e., the benchmark airports in our regression models), it is important for governments to sell a majority stake in airports when they wish to seek private sector financing or participation in ownership and management of airports. In short, the airports with a government majority and/or with multiple government involvement tend to have significantly lower operating efficiency than those with other ownership forms.

5.3 Effects of Business Diversification

The % NonAviation variable is the most statistically significant variable and has a positive coefficient in all of the VFP regressions reported in Table 3. This indicates that diversifying revenue sources into commercial and other non-aeronautical business would help airports to achieve higher

operating efficiency. Many airports aim to increase revenues from commercial services and other non-aeronautical activities, in order to reduce aviation user charges thus attracting more airlines. Such business diversification strategies, of course, exploit the well known demand complementarity between aeronautical services and commercial services (Oum, Zhang and Zhang (2004)) and appear to improve airport productive efficiency as well.

The result from a one-way ANOVA analysis (Table 4) shows that airports with a private majority ownership generally derive a higher percentage of their revenue from non-aeronautical activities than their counterparts under other ownership forms: e.g. 57% versus 37% for airports with a government majority. If airport privatization leads to an increase in non-aviation revenue, and in turn, an airport with proportionally higher non-aviation revenue achieves greater efficiency, then this secondary effect of privatization on efficiency over and above the effect of the privatization dummy variable should be counted as the total efficiency effect of privatization. Once we take this into account, the effect of privatization on efficiency may be larger than the result presented in this section (and in Table 3). [10]

5.4 The Effects of Airport Characteristics

All of the airports characteristic variables had the expected coefficient signs in the VFP regression. These variables are included in order to avoid bias in efficiency comparisons. The effects of these variables are as follows:

- **Airport size** (scale of output) has a positive coefficient in all three models, but is not always statistically significant. This provides some indication that the economies of output scale may have been exhausted for most of the airports included in our sample (mostly more than 3 million passengers). This is consistent with the findings of Jeong (2005).
- **Runway Utilization** has a positive coefficient, but is not statistically significant in Model (3) and is only marginally significant in Model (2). This provides some indication that airports with congested runways tend to have higher gross VFP.

[10] In order to test if this secondary effect of private ownership on efficiency is significant, we ran the same set of three regressions reported in Table 3 after removing %NonAviation variable. The coefficients for the ownership dummy variables in the new set regressions were not significantly different from those reported in Table 3.

- **Average aircraft size (number of passengers per air transport movement)** has a statistically significant negative coefficient in the first order term, but statistically significant positive coefficients for the cross terms with Asia and Europe regional dummy variables in Model 3. The results indicate that in North America airports handling larger aircraft tend to have lower operating efficiency as compared to a similar airport handling smaller aircraft. This may have been caused by the fact that arrivals and departures of larger aircraft tend to pose peaking and congestion problems at the terminal and landside operations thus reducing the efficient utilization of airports throughout the day. In Asia and Europe, however, airports serving larger aircraft tend to have higher efficiency than those serving smaller aircraft. This provides some indication that Asian and European airports are more concerned with runway congestion, and larger aircraft would release some runway congestion pressure, thus helping to improve overall productive efficiency.
- **%International** has a negative coefficient in its first order term, but is not statistically significant. However, the cross term with the European regional dummy is statistically significant with a negative coefficient, and the cross term with the Asian regional dummy is statistically significant with a positive coefficient. The results provides some evidence that in North America and Europe, airports with a heavy reliance on international passengers are likely to have lower 'gross' VFP, whereas in Asia, airports with proportionately more international traffic tend to have a higher "gross" VFP.
- **%Cargo** has a positive coefficient, but is not statistically significant. This provides weak evidence that airports with a larger proportion of cargo traffic are expected to have higher VFP.

5.5 Ownership Influences on Other Factors

Ownership forms are likely to influence airport pricing and profitability.. A series of one way ANOVA analysis were conducted to examine the effects of ownership form on airport profitability and airport charges.

- **Effects on Profitability:** Table 5 shows that airports with a private majority achieve significantly higher profit margins (56%) than airports under other ownership forms. In particular, their average operating margins are more than double those of airports with a government majority and/or operated by multiple governments. North American airports operated by airport authorities also achieved considerably higher profit margins than other types of government operated airports.
- **Effects on Airport Charges:** Table 6a and 6b show that airports in North America generally have lower aeronautical charges than their counterparts in other regions. Outside North America, airports with a private majority have significantly lower average aeronautical charges than other airports. The results provide some evidence that privatization has not lead to airports charging monopoly prices. Instead, privatized airports tend to enhance their profitability by diversifying their business into commercial and other non-aeronautical activities. In contrast, the airports owned/operated by multiple governments appear to rely more on aeronautical charges than the others because they are relatively inefficient.

6. Summary and Conclusions

This paper investigates the effects of ownership forms and governance structure on the performance of airports around the world, focusing on productive efficiency and operating profitability. The efficiency measure was based on a variable factor productivity (VFP) index drawing from an extensive set of unbalanced panel dataset including major airports in Asia-Pacific, Europe and North America over the period of 2001-2003.

Contrary to initial expectations, we found strong evidence that airports owned and managed by a mixed enterprise with a government-owned majority is significantly less efficient than 100% publicly owned and operated airports.

Again, contrary to common belief, there is no statistical evidence indicating that the airports owned/operated by a firm with private sector majority ownership are more efficient than the airports owned/operated by the U.S. government branches or 100% public corporations. Furthermore, no statistically significant difference in efficiency performance was found to separate airports managed by government departments/branches in the U.S. and those managed by airport authorities such as Vancouver International Airport Authority. The data also suggests that government majority ownership and ownership by multiple governments (often federal/state/local governments) are the two most inefficient ownership forms.

Airports with a private majority, all of which are based in Europe and Oceania, achieved significantly higher profit margins (56%) than airports under other ownership forms despite the fact that they charge significantly lower aeronautical tariffs than other airports. Hence, the results provide some evidence that privatization has not lead to airports charging monopoly prices. Instead, privatized airports tend to enhance their profitability by diversifying their business into commercial and other non-aeronautical activities.

Probably the most surprising result of this analysis is that 100% public (single government owned) airports are more efficient than the PPP (Public Private Partnership) airports, where a government retains majority ownership and control. Given that the airports operated by 100% government-owned corporations are almost as efficient as the airports with either 100% or a majority stake in the private sector, it would appear to be important for governments to sell a majority stake in airports when they seek private sector financing or participation in ownership and management of airports. In short, the airports with a government majority and/or with multiple government involvement tend to have significantly lower operating efficiency than all other forms of ownership. Furthermore, airports with majority private ownership (including 100% private ownership) do not achieve significantly higher efficiency than the 100% government-owned airports, such as those in the U.S.

These results lead to the following question: why has privatization failed to improve productivity in the airport industry? The near monopoly markets for many airports (Victor and Yarrow, 1991), the type of regulation imposed (Oum, Zhang and Zhang, 2004) and the principal-agent issues (De Fraja, 1993; Cragg and Dyck, 1999) all may have led to the problems depicted in this analysis.

Consequently, institutional changes along with some or all of the following measures may help improve airport's operational efficiency:

- In the long run, creation of a continental single aviation market would encourage greater competition amongst airport markets by providing airlines and passengers with greater choices.
- Removing bureaucratic control and duplication of administrative processes between the corporatized airport management and governmental administrative procedures.
- Giving airport managers complete authority to restructure operations and conduct business may improve efficiency e.g. the airport managers should be given the freedom to outsource terminal operations to specialized firms.

Researchers have pointed out that the empirical results of efficiency analysis may depend on the method of measurement used (Oum, Waters and Yu, 1999). Other methodologies, such as various forms of DEA, stochastic frontier methods, cost function methods, etc. are likely to yield different empirical results. Given that some of the findings obtained here are likely to be controversial, it is important to test different measurement methodologies before reaching a firm conclusion as to the efficiency effects of privatization, corporatization and commercialization of airports.

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Table 1:
Airport Ownership and Governance as of Dec, 2003

Airport Code	Airport Name	Ownership/Governance
ATL	Atlanta William B Hartsfield International Airport	government department
BNA	Nashville International Airport	Authority
BOS	Boston Logan International Airport	Authority
BWI	Baltimore Washington International Airport	government department
CLE	Cleveland-Hopkins International Airport	government department
CLT	Charlotte Douglas International Airport	government department
CVG	Cincinnati/Northern Kentucky International Airport	Authority
DCA	Ronald Reagan Washington National Airport	Authority
DEN	Denver-Stapleton International Airport	government department
DFW	Dallas/Fort Worth International Airport	Authority
DTW	Detroit Metropolitan Wayne County Airport	Authority
EWR	Newark International Airport	Authority
FLL	Fort Lauderadale Hollywood International	Authority
HNL	Honolulu International Airport	government department
IAD	Washington Dulles International Airport	Authority
IAH	Houston-Bush Intercontinental Airport	government department
IND	Indianapolis International Airport	(Private) Authority
JFK	New York-John F. Kennedy International Airport	Authority
LAS	Las Vegas McCarran International Airport	government department
LAX	Los Angeles International Airport	government department
LGA	LaGuardia International Airport	Authority
MCI	Kansas City International	government department
MCO	Orlando International Airport	Authority
MDW	Chicago Midway Airport	government department
MEM	Memphis International Airport	Authority
MIA	Miami International Airport	government department
MSP	Minneapolis/St. Paul International Airport	Public Corporation
ORD	Chicago O'Hare International Airport	government department
PDX	Portland International Airport	Authority
PHL	Philadelphia International Airport	government department
PHX	Phoenix Sky Harbor International Airport	government department
PIT	Pittsburgh International Airport	Authority
RDU	Raleigh-Durham International Airport	Authority
SAN	San Diego International Airport	Authority
SEA	Seattle-Tacoma International Airport	Authority
SFO	San Francisco International Airport	government department
SJC	Norman Y. Mineta San José International Airport	government department
SLC	Salt Lake City International Airport	government department
STL	St. Louis-Lambert International Airport	government department
TPA	Tampa International	Authority
YEG	Edmonton International Airport	Authority
YOW	Ottawa International	Authority
YUL/YMX	Aéroports de Montréal	Authority
YVR	Vancouver International Airport	Authority
YYC	Calgary International Airport	Authority
YYZ	Toronto Lester B. Pearson International Airport	Authority

Table 1
Airport Ownership and Governance (cont.)

Airport Code	Airport Name	Ownership/Governance
AMS	Amsterdam Schiphol International Airport	Multi-Level Government
BCN	Barcelona El Prat Airport	Public Corporation
BRU	Brussels International Airport	Government Majority
CDG	Paris Charles de Gaulle International Airport	Public Corporation
CGN	Cologne/Bonn Konrad Adenauer International Airport	Multi-level government
CPH	Copenhagen Kastrup International Airport	Private Majority
DUB	Dublin International Airport	Public Corporation
DUS	Flughafen Dusseldorf International Airport	50%-50% Gov. Private
EDI	Edinburgh Airpor	Private Majority
FCO	Rome Leonardo Da Vinci/Fiumicino Airport	Private Majority
FRA	Frankfurt Main International Airport	Multi-level government with minor priv.
GVA	Geneva Cointrin International Airport	Public Corporation
HAM	Hamburg International Airport	Government Majority
LGW	London Gatwick International Airport	Private Majority
LHR	London Heathrow International Airport	Private Majority
MAD	Madrid Barajas International Airport	Public Corporation
MAN	Manchester International Airport	Multi-level government
MUC	Munich International Airport	Multi-level government
MXP	Milan Malpensa International Airport	Multi-level government
ORY	Paris Orly Airport	Public Corporation
OSL	Oslo Airport	Public Corporation
PRG	Prague International Airport	Public Corporation
VIE	Vienna International Airport	Private Majority
WAW	Warsaw Frederic Chopin Airport	Public Corporation
ZRH	Zurich International Airport	Private Majority
ADL	Adelaide International Airport	Private Majority
AKL	Auckland International Airport	Private Majority
BKK	Bangkok International Airport	Authority/Public Corporation (since Sept'02)
CHC	Christchurch International Airport	Multi-Level Government
CNS	Cairns International Airport	Public Corporation
HKG	Hong Kong Chek Lap Kok International Airport	Authority
ICN	Incheon International Airport	Public Corporation
KIX	Osaka Kansai International Airport	Multi-level government with minor priv.
KUL	Kuala Lumpur International Airport	Government Majority
MEL	Melbourne Tullamarine International Airport	Private Majority
NRT	Tokyo Narita International Airport	Authority/Public Corporation (since April'04)
PEK	Beijing Capital International Airport	Government Majority
PEN	Penang International Airport	Government Majority
PVG/SHA	Shanghai Airport Authority	Government Majority
SEL	Seoul Gimpo International Airport	Public Corporation
SIN	Singapore Changi International Airport	Government Department
SYD	Sydney Kingsford Smith International Airport	Public Corporation/Private Majority since July'02

Table 2
Characteristics of Selected Airports, 2003

Airport	*Passengers (000)*	*Passengers/Movement*	*%International Passengers*	*% Aeronautical Revenue*	*% Dominant Carrier*
North America (50 airports)					
ATL	79,087	87	6.9%	36%	74%
BOS	22,604	59	16.9%	47%	24%
CLT	22,655	52	5.9%	53%	85%
DFW	52,455	69	8.4%	58%	64%
FLL	17,938	62	7.4%	37%	16%
IND	7,360	36	1.2%	45%	19%
JFK	31,735	113	48.2%	73%	22%
LAX	55,307	87	26.3%	43%	30%
MCI	9,573	52	0.7%	32%	34%
MSP	33,200	65	4.3%	46%	79%
ORD	69,509	75	13.4%	65%	47%
PIT	14,267	40	3.1%	72%	82%
RDU	8,344	36	2.4%	38%	16%
SFO	29,165	86	23.1%	70%	56%
TPA	15,311	66	2.8%	32%	22%
YOW	3,263	47	23.6%	55%	58%
YVR	14,322	57	49.3%	46%	41%
YYZ	24,739	67	55.4%	67%	61%
Mean	22,315	60	13%	53%	51%
Europe (33 airports)					
AMS	39,960	102	99.6%	49%	52%
CPH	17,714	68	91%	54%	50%
GVA	8,049	60	99%	49%	46%
LGW	30,058	128	86%	45%	45%
LHR	64,261	139	88%	50%	41%
MUC	24,193	71	65%	33%	64%
STN	19,409	100	82%	38%	56%
VIE	12,785	65	98%	42%	58%
ZRH	17,025	63	95%	53%	51%
Mean	19,417	80	75%	53%	52%
European Airport Authorities (10 authorities)					
ADP	70,700	100	n/a	45%	n/a
Aer Rianta	20,439	91	n/a	25%	n/a
ANA	18,076	89	n/a	57%	n/a
Berlin	12,076	56	n/a	57%	n/a
Fraport AG	70,558	98	n/a	46%	n/a
Mean	54,441	79		48%	
Asia Pacific (33 airports)					
AKL	9,748	65	55%	36%	70%
BNE	12,340	90	21%	32%	50%
HKG	27,092	143	100%	44%	25%
ICN	19,790	152	98%	47%	37%
KIX	16,921	156	62%	40%	25%
NRT	26,537	156	85%	68%	24%
PEK	24,364	103	23%	50%	37%
SIN	24,664	141	100%	42%	39%
SYD	24,183	95	33%	41%	48%
TPE	15,514	123	88%	48%	29%
Mean	13,120	105	45%	47%	40%
Asia Airport Authorities					
AAI	46,642	60	35%	76%	n/a
AOT	36,274	149	63%	61%	n/a
MAHB	34,139	65	62%	76%	n/a
SAA	24,756	102	33%	n/a	n/a
Mean	35,453	94	48%	71%	

Source: Air Transport Research Society (2005)

Table 3

Variable Factor Productivity Regression Results – Log-Linear Model (Base ownership: airport with a private majority)

Model	1		2		3	
Dependent Variable	VFP		VFP		VFP	
	Coeff.	t-stat	Coeff.	t -stat	Coeff.	t-stat
Intercept	0.776	-	-0.531	-	0.689	-
Output Scale (Index)	0.080	1.99	0.029	0.58	0.076	1.56
Runway Utilization (ATM per Runway)	-	-	0.101	1.71	0.045	0.80
Aircraft size (Pax /ATM)	-0.161	1.94	-0.128	1.51	-0.303	3.19
* Europe	-	-	-	-	0.599	3.74
* Asia-Pacific	-	-	-	-	0.628	2.83
%International	-0.010	0.51	-0.008	0.38	-0.035	1.65
* Europe	-	-	-	-	-0.316	1.96
* Asia-Pacific	-	-	-	-	0.139	3.52
%Non Aviation	0.574	9.04	0.565	8.92	0.504	7.70
%Cargo	0.019	0.65	0.021	0.74	0.013	0.45
Asia	-0.623	4.60	-0.612	4.52	-3.403	3.17
Europe	-0.453	3.40	0.234	0.55	-2.720	3.03
Oceania	0.410	2.72	0.432	2.86	0.508	3.58
2002	-0.066	1.35	-0.060	1.22	-0.054	1.18
2003	-0.081	1.66	-0.069	1.40	-0.067	1.45
Ownership/Governance Form Dummy Variables:						
U.S. Govt Department	-0.046	0.34	-0.031	0.24	-0.056	0.44
N. America Airport Authority	0.026	0.18	0.047	0.34	0.0176	0.13
100% Public Corporation	-0.047	0.54	-0.038	0.44	-0.012	0.14
Mixed Ent. (majority-gov)	-0.341	2.95	-0.303	2.58	-0.225	1.98
Multi-Gov shareholders	-0.287	2.91	-0.264	2.65	-0.331	3.51
R^2	0.6846		0.6885		0.7336	
Adjusted R^2	0.6647		0.6674		0.7107	
Log-Likelihood Value	-57.27		-55.71		-35.84	
Observations (n)	254		254		254	

Note: All variables including the dependent variables are in logarithmic form except for dummy variables; VFP = Variable Factor Productivity index.

Table 4
Ownership Form vs Shares of Non Aeronautical Revenue

Groups	Count	Sum	Average	Variance
N. American Airport Authorities	78	35.87	46%	0.016
Public Corporation	44	21.02	48%	0.020
Government majority	14	5.25	37%	0.014
Private-Majority	32	18.20	57%	0.013
Multi-Government.	16	8.72	55%	0.018
US Government Dept	70	34.65	50%	0.014
Source of Variation	SS	df	MS	F
Between Groups	0.510	5	0.102	6.447
Within Groups	3.928	248	0.016	
Total	4.439	253		

Table 5
The Effects of Ownership on Operating Margin

Groups	Count	Sum	Average	Variance
N. American Airport Authorities	27	10.62	39%	0.012
Public Corporation	16	5.80	36%	0.153
Government majority	5	0.98	20%	0.092
Private-Majority	16	9.02	56%	0.016
Multi-Government.	6	1.37	23%	0.082
US Government Dept	26	8.09	31%	0.041
Source of Variation	SS	df	MS	F
Between Groups	0.975	5	0.195	3.771
Within Groups	4.653	90	0.052	
Total	5.628	95		

Table 6a
The Effects of Ownership on Airport Charges Aeronautical Revenue per Passenger

Groups	Count	Sum	Average	Variance
N. American Airport Authorities	26	150.08	5.77	11.88
Public Corporation	16	159.67	9.98	84.10
Government majority	5	42.16	8.43	15.95
Private-Majority	16	106.67	6.67	13.01
Multi-Government.	5	70.23	14.05	83.01
US Government Dept	26	155.49	5.98	37.27
Source of Variation	SS	df	MS	F
Between Groups	461.196	5	92.238	2.634
Within Groups	3081.453	88	35.016	
Total	3542.644	93		

Table 6b
The Effects of Ownership on Airport Charges Aeronautical Revenue per Work Load Unit*

Groups	Count	Sum	Average	Variance
N. American Airport Authorities	26	123.55	4.75	6.93
Public Corporation	16	125.67	7.85	47.13
Government majority	5	35.91	7.18	11.53
Private-Majority	15	90.07	6.00	9.20
Multi-Government.	5	49.56	9.91	28.30
US Government Dept	26	129.43	4.98	30.05
Source of Variation	SS	df	MS	F
Between Groups	206.019	5	41.204	1.867
Within Groups	1919.567	87	22.064	
Total	2125.586	92		

* A Work Load Unit (WLU) defined as one passenger or 100 kg of cargo.