CAN INTERNATIONAL COMPARISONS OF AIR FARES BE MADE?

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Summary

The central argument of this paper is that international comparisons of air fares (or other output prices) can be made, but to be valid, they need to be related to other prices; normally, input prices. Thus comparisons which are typically made have no clear meaning. Prices of goods and services differ between economies, but this tells nothing about the performance of industries which produce them. To obtain an indicator of productivity or efficiency, it is necessary to relate output to inputs, or output prices to input prices. Air fare comparisons can be useful, as they are a way of comparing output prices; to show light on performance, it is necessary to compare them to input prices. Another problem with air fare comparisons as usually done is that the results alter with exchange rates; a valid measure of efficiency would be invariant to exchange rates.

As an illustration, a comparison was made of economy/coach fares in Australia, the U.S. and the U.K. Equations relating fares to distance were estimated for various years between 1975 and 1985 - a period over which there were major changes in exchange rates. Input price indexes for these years were calculated for each country; these were found to differ by as much as 50%. During the period 1980 to 1985, relative air fares changed substantially (due to exchange rate movements). When fares were related to input prices, the changes were much reduced, though not eliminated. This was because the structure of
1. Introduction: The Validity of Fare Comparisons

International comparisons of air fares are often made. A fare on a route in one country is compared to the fare on a route in another country, with the fares in different countries being reduced to common terms with the use of the current exchange rate. Varying degrees of care may be exercised in selecting the routes for comparison, but typically strong inferences will be drawn from the results. It may be claimed that air fares in a country are "too high" or "low", and it may be further asserted that airlines of that country are efficient or inefficient.

Comparisons may be made at different levels. The individual traveller cannot but help notice that he or she pays widely differing prices for similar services. In the press, comparisons of air fares are often made because they illustrate the point of an article in easily understood terms. Lately, there have been a number of comparisons made in government reports and professional journals. The intention is usually to obtain a measure of the performance of an airline system. Airline deregulation in the U.S. has meant that many have been interested in comparing the performance of other countries' airlines with those of the U.S., and air fare comparisons often form part of the evaluation.

For example, comparisons of U.S. and European fares are often made. The Airline Users Committee (1976) and the U.K. Civil Aviation Authority (CAA) and Department of Trade (1980) have made
this comparison. In Australia, the Domestic Air Transport Policy Review (1978) compared U.S. and Australian fares, as did Forsyth and Nocketing (1980), and the Bureau of Transport Economics (1985). Consumer magazines such as Choice (1984) have made comparisons of air fares, and the problem has been considered in accounting journals (Notley, 1985). A major problem is that of comparing like with like, and in two recent studies, considerable care has been taken to ensure that routes are comparable—these are studies by the CAA (1983) and Tregrove (1985). The CAA report discusses in detail the problems of finding routes that are truly comparable.

The points made by the CAA are accepted here. However, the difficulties in making international comparisons are more severe than generally recognised. For prices in different countries to mean anything very much, they must be compared to other prices. Otherwise they tell nothing about relative performance of an industry, or whether particular goods and resources are cheap or expensive.

Direct comparisons of prices of goods and services between countries are always possible, but rarely is much meaning attached to them. We are not surprised to find that a haircut costs less in India than in the U.S., or that electricity prices and hotel rates differ from country to country. There are good reasons why prices of goods and services differ between countries, and these should not be ignored if comparisons are made. Comparisons of other transport prices are sometimes made across countries—for example airport fees (see BAA, 1983), rail fares and freight rates. These are subject to the same problems as air fare comparisons. Direct comparisons across countries of air fares can be both illegitimate and misleading. The problem is that typically, all other prices in the economy will differ. This means that the relationship of air fares to other prices, i.e. the relative price of air travel, will not be as indicated using exchange rate conversions. More seriously, however, input prices will differ, so that there is no presumption that air fares should be the same for equally efficient airlines. This is the essence of the issue.

A problem which has been recognised, however, is that of exchange rates (CAA, 1983, pp.13-14) and Bureau of Transport Economics (1985, p.52). Exchange rates can, and sometimes do, alter rapidly, and thus the results of fare comparisons change. There is the problem of choosing between two sets of comparisons of apparently equal validity, yet which can have quite different implications. This problem is occasionally recognised, but no solution to it is offered. In fact, as will be shown later, this apparent problem only arises because input prices have been incorrectly excluded. Once they are allowed for, exchange rate changes create no problems, conceptual or otherwise.

In this paper, a method is developed which enables comparisons of air fares across countries which convey information about performance. It is first useful to consider the
possible uses to which such comparisons might be put - this is
done in section 2. The general problem of efficiency measurement
is examined in section 3, and the use of fare comparisons as an
indicator of efficiency is discussed. In section 4, an approach
to making air fare comparisons is developed and applied to the
U.S., the U.K. and Australia. The emphasis is on developing a
method for comparison. While it is applied to air fares, it can
equally well be applied to comparisons of other fares, or freight
rates, or the prices of outputs other than transport.

2. Possible Uses of Fare Comparisons

There are a number of distinct questions that can be asked
about air fares in different countries. Four are identified here.
Attention in the paper is directed to the last two, which are
closely related; it is these which deal with the performance of
the industry, and the level of air fares which might be possible
in a country.

Firstly, the absolute level of air fares may be of interest.
A particular service in one country may cost US$100, while in
another an equivalent service may cost only US$50. The
difference in prices could arise for a number of reasons, such as
different input prices, or different efficiency levels of the
producers. Comparisons of absolute levels are of little interest
unless there is the possibility of trade, which, with airline
services, there may be. If the second country could operate the
service in the first country for US$50, there is the possibility

of gains from trade. With international airlines, this
possibility is quite real. Countries do trade in airline
services, and some have a comparative advantage in providing them
(see Findlay and Forsyth, 1984). Where a comparison is being made
of routes internal to regions, e.g. across internal Europe,
domestic U.S. and domestic Australian routes, there is little
chance that an airline from one region could service another
region at the same price. Unless trade is possible, comparisons
of absolute levels of air fares are of limited value, since they
say nothing about the industry's performance or how high fares
might be.

Secondly, we may be interested in the relative price of air
services in a country. The comparison may be with the prices of
other goods in general, or with the price of some particular
good or service, such as that of labour. If the former comparison
is made, it must be recognised that exchange rates are typically
inaccurate measures of purchasing power differences between
countries. At current exchange rates, US$1 will go further in
some countries than others. What is needed is a purchasing power
parity exchange rate. For example, an air fare may be US$100 in
one country and US$120 in another. If, however, the purchasing
parity rate (see below, section 4) were 1.5 times the official
rate, US$100 in the first country would purchase as much as
US$150 spent in the second. Air fares in the second country are
thus relatively low, not high. With information on purchasing
power of different currencies (see Kravis et al 1978),

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comparisons of the relative levels of air fares can be made (see Forsyth and Hocking, 1980).

Such comparisons may be interesting, but they do not lead to any specific policy conclusions. Relative prices in different countries differ because of different real income levels, tax structures and protective policies. Relatively low air fares may help to explain relatively high demand for air travel in a particular country, but there is no particular policy interest—low relative air fares are neither specifically desirable nor undesirable.

The third and fourth questions are the most important, as they deal with the performance of the industry. Comparisons of air fares can be made to obtain a measure of efficiency of the industry. The implication is often drawn that, if fares in another country are lower, the airlines in that country are more efficient (or, if they are higher, the reverse implication is drawn). However, it is not possible to obtain measure of efficiency by looking at output prices without simultaneously considering input prices; thus such comparisons are misleading. Nevertheless, international comparisons of efficiency are desirable as they are often the only means of assessing performance of a given system. To obtain valid comparisons, it is necessary to allow for input, as well as output, prices.

The fourth question is essentially the same as the third, though with a different emphasis. If airline systems were operating with equal efficiency, what might the fares be in different countries for services with the same characteristics? Again, it is necessary to know what the input prices in different countries are. For example, it may be of interest to know what fares might be charged in the UK or Australia if an airline with similar characteristics and efficiency to those of recent new entrant airlines in the US were to operate.

Air fare comparisons have the advantage of simplicity, but this is of no use if they are misleading (and this is invariably the case, since they are incomplete, making no allowance for input costs). What are needed are workable methods of making comparisons which provide information on relative performance. Before this is done, it is appropriate to fit air fare comparisons into the general problem of measuring efficiency.

3. International Comparisons of Efficiency

Efficiency comparisons can be made at various levels of generality. The most general method is to estimate a cost or production function across a number of observations of airlines. This enables standardisation for the different output characteristics and input prices. It is then possible to estimate at what cost a given airline might have been able to produce another airline’s output, given the other airline’s input costs. The difference between the two is the measure of relative efficiency. A lower level of generality involves estimating
indexes of inputs and outputs (or input and output prices) for a
group of airlines (with bases for the indexes taken from the
input and output shares of the airlines being compared). The
result is a measure of total factor productivity differences.

The estimation of cost functions need not be discussed in
any detail here. Several cost or production functions have been
estimated for airlines. Some of these, such as those by Sarndal,
Oum and Statton (1976) and Caves, Christensen and Threlkeld
(1983) have been estimated for airlines within one country. Given
that technology available is the same, the parameters of the
function should be similar for international airlines. Studies
which estimate costs or productivity across countries, over a
time sample in which input costs are likely to vary considerably,
include those of Straszheim (1969, Appendix B), the C.A.A.
(1977), Pearson (1976), Mckay (1978) and Findlay and Forsyth
(1984). The theory of measurement of productivity differences
between airlines (and in general between firms), along with
estimates for the US, are given in Caves, Christensen and
Threlkeld (1981). Estimation of productivity change over time
include Air Transport Association of America (1974) and Ashworth
and Forsyth (1984). Any of these would provide a basis for
measuring efficiency differences between airlines.

There are a number of problems associated with estimates of
efficiency using cost or production functions, or total factor
productivity measures. Some will also be present when air fares
are compared. (1) there is the problem of determining the
appropriate form of the function to be used; (2) there are
econometric problems, such as multicollinearity, which limit the
reliability of estimates; (3) there are aggregation problems
which arise from adding together diverse outputs and inputs
(there must usually be made for whole airlines, not single
routes); (4) there can be aggregation difficulties where fare
structures differ; (5) there are difficulties in allowing for
quality differences, which are often unquantifiable or
unobservable.

One problem which does not arise is that of exchange rate
changes. The results from such a study are almost invariant to
them. If costs, converted into some other currency of an airline
rise because its home currency has been revalued, the airline
will not have become any less efficient. Its output per unit of
input will be (virtually) unchanged. However, the measure of
efficiency from a cost function is not completely invariant; and
this is a desirable property. When exchange rates change, the
relative prices of different airline inputs (which include
tradable and non-tradable inputs) change. Given the production or
cost function, the efficient choice of factors will change,
though only slightly. Typically, airlines do not have optimal
factor mixes at any particular point of time - it takes time to
adjust to new factor prices. Thus, there is invariably an element
of inefficiency resulting from the factor price change. (For
example, which airlines in 1980 did not wish that they had more
fuel efficient aircraft?) If an airline in June has an optimal
input mix, but if the exchange rate changes, then in July it
will have a (slightly) inefficient mix (unless it can adjust
instantaneously). Thus, dependent on the coefficients for input
substitution, efficiency measures will change slightly if
exchange rates change; but this is a desirable property.

The interpretation of results is quite straightforward. The
importance of the aspects which differ between airlines,
including output characteristics (stage lengths, load factors,
and market density) and input prices (for labour, fuel, capital
and other inputs) can be standardised for. It is then possible to
compare a given airline’s cost with that of another (for
standardised output mix and input prices), with that of the
industry average, or the estimate minimum possible cost. With
productivity comparisons (output per unit of input or output
prices relative to input prices) the efficiency of different
airlines may be compared.

Fare comparisons, as such, are not indicators of relative
performance. However, with information about input prices they
can easily be converted into such indicators. They have some
advantages over the more explicit measures of efficiency. Since
they can be made for actual routes or groups of routes, they are
easy to conceptualise. Secondly, and more importantly, they can
be chosen so that routes can be made as comparable as possible.
The problem with many overall efficiency comparisons is that
output characteristics differ between airlines, and it is
difficult to standardise for them accurately. With route by route
comparisons, if routes are not identical, it is usually easy to
obtain information on how they differ. On the output side, with
care in selection, it is possible to compare like with like.

There are problems with route comparisons as well.
Inevitably, only a small sample of routes in each system is being
compared. These samples may be unrepresentative – for example, to
obtain similar routes, the most dense routes of one country may
be compared with the medium density routes of another. Within an
overall system, there need be no presumption that fares equal
cost. For many reasons, cross-subsidisation may be possible, and
present e.g. between intra-European and other routes operated by
European airlines. A comparison of "similar" routes may involve
those from one country being profitable routes, and those from
another being loss makers. Output prices may tell very little
about costs of efficiency. Nevertheless, in most airline systems,
if cross-subsidisation is present, it is unlikely to be so great
that fare comparisons are of no use.

When it is a matter of answering the fourth question of
section 2, fare comparisons are a convenient way. A common query
is, how low could air fares be if, for example, the efficiency of
other systems were achieved? This is best answered by comparisons
of actual fares, with allowance for differing input prices.
4. Making Air Fare Comparisons

If air fare comparisons are to be made with a view to obtaining information on the performance of the industry, the key problem is one of obtaining an indicator of input prices in the different countries. Air fares are usually reduced to some common currency for comparability, and the same must be done to input prices. The two stages are (1) aggregating different input prices and (2) converting to common terms. This exercise can be undertaken in either order. It is often convenient to undertake the second step first.

Several inputs can be explicitly considered in construction of the price-index. One main input for airlines is labour, and another is fuel, and evidence on prices for these is available. Another input is capital equipment, in the main, aircraft. Little evidence on prices actually paid for this is available, and the same is true for interest rates actually paid on borrowings. However, the variation in prices paid by different airlines is not likely to be great. The remainder of costs are accounted for in what may be described as "other" inputs. These include airport and air navigation fees (rarely more than 5% of total costs), services purchased by airlines, such as advertising, food, commissions and so forth. This is something of a catch all category. The proportions of total costs are, roughly, labour 25-40%, fuel 20-30%, capital equipment 10-20% and "other" 20-40%. Airlines make different decisions about whether they undertake tasks in-house or contract them out. Thus, it is dangerous to exclude the "other" input and analyse solely in terms of value added.

Airlines use both tradable and non-tradable inputs. Some inputs are clearly tradable - for example, aircraft and fuel, and their prices are set on international markets. Others are non-tradable. These include domestic labour, services purchased in a particular country, and airport and navigation charges. Between these, some services, such as managerial expertise, may be tradable or non-tradable.

This distinction is important when exchange rates vary. Suppose that a country devalues by 20%, and for its domestic airlines 50% of their costs are accounted for by tradable inputs, and 50% by non-tradables. If airline efficiency is unchanged, the price in domestic currency of tradable inputs will rise by 20%, and for non-tradables, there will be no change. Overall, costs rise by 10% in domestic currency terms, and fall by 10% in foreign currencies. The ratio of total costs, or prices, to input prices is unaltered. If an airline of this country is competing against airlines of the other countries, it will have gained a 10% cost advantage. This gain in competitiveness is enjoyed, to a greater or lesser degree, by all goods and services produced by the country. The efficiency performance of the airline industry is unaffected by the exchange rate change, and the ratio of costs or prices to input prices reflects this.
The distinction between tradable and non-tradable inputs is the key one, and the issues of where inputs are purchased is a secondary one. Fuel is, for the most part, internationally priced whether it is purchased internationally or domestically (though different countries tax fuel differently). A more important practical problem arises where an airline purchases non-tradable inputs in several countries – e.g. an international airline buys advertising in many countries. In such cases, it is difficult to obtain accurate information on the prices actually paid for inputs. However, even most international airlines purchase the majority of their non-tradable inputs at home.

Price indexes for inputs were constructed for airlines of three countries (the US, the UK and Australia) for the period 1975 to 1985. The years 1980, 1983, 1984 and 1985 were selected for special attention. As far as was possible, input prices were drawn from actual prices paid by three airlines – American Airlines (a major trunk airline) in the US, British Airways and Trans Australia Airlines (TAA) (one of the two trunk airlines in Australia). This sample of airlines was selected for convenience, and is not intended to be representative. The traffic of American and TAA was mainly domestic; British Airways carries traffic on domestic, European and Intercontinental routes (there is no major, solely domestic UK airline). Data for individual airlines for the later years is unavailable, and input prices have been estimated from movements in general price movements (e.g. the labour price was assumed to rise in the same proportion as wages generally in economy). This means that input prices for the later years are unavoidably less reliable than those for the earlier years.

Price indexes must be calculated for airlines over time, and between airlines at a given point of time. 1980 was taken as the base year. Simple time series indices were calculated using 1980 quantities as weights; according to the formula:

\[ \Pi_2 = \left( \sum_{i=1}^{4} x_i \frac{p_2^i}{p_1^i} \right) \Pi_1 \]

where \( \Pi_2, \Pi_1 \) = price index in 1, 2
\( x_i \) = 1980 quantities for inputs 1...4
\( p_1^i \) = input prices in year 1
\( p_2^i \) = input prices in year 2

This approach is valid for a short period, during which input proportions do not change.

This assumption is unlikely to hold for cross-country comparisons. Firms in different countries have had a long period to adjust to different input prices, and input proportions will vary in consequence. The index chosen must make allowance for this. To make cross-country comparisons in 1980, a Törnquist Index, consistent with a trans log cost function, was used.
This index is given by:

$$\ln \pi^*_A = \ln \frac{\pi_A^i \psi^*_A^{i\text{a}} \ln \frac{\pi_B^i}{\pi_A^i}}{4 \sum_{i=1}^3 \frac{\psi^*_A^{i\text{a}} + \psi^*_A^{i\text{b}}}{2} \ln \frac{\pi_B^i}{\pi_A^i}}$$

where $
\pi^*_A, \pi^*_B$ = price indexes for $A, B$
$\psi^*_A^{i\text{a}}, \psi^*_A^{i\text{b}}$ = input shares for input $i$ in $A, B$
$\pi^*_A^i, \pi^*_B^i$ = input prices for input $i$ in $A, B$
$\bar{\psi}^i$ = arithmetic mean of input shares in $A$ and $B$
$\bar{\pi}^i$ = geometric mean of input prices in $A$ and $B$.

(On the advantages and disadvantages of this index, see Caves, Christensen and Threlkeld, 1981). The US was taken as a base, and binary comparisons with the UK and Australia were made. The time series for each country, and the cross-section between countries for 1980 were combined to form the input price indexes in Table 1. Separate cross-country indexes could have been calculated for each year; they would have required much more data (some of which is unavailable for 1984 and 1985), and the gain in accuracy would most likely have been small.

The indexes in Table 1 are expressed entirely in terms of $\$US$. For the cross-country comparison, in a given year, this involves converting prices in each country to $\$US$ terms by use of the current exchange rate. Movements over time in the input price index in domestic currency terms are adjusted by the change in exchange rates. Thus, if domestic price index rises from 100 to 120, but there is a 10% devaluation with respect to the $\$US$, the input price index in $\$US$ terms rises to 108.

Information on renumeration per employee was readily obtained, and evidence on fuel prices was adequate. It was assumed that the prices of capital goods to the UK and Australia were 10% higher than the US. This arbitrary adjustment reflects the fact that the US is the main supplier of equipment, and distance from the supplier may add to costs (e.g. in greater spares stockpiles). Capital input prices were assumed to rise according to the US capital equipment price index.

The price of the "other" input category gave rise to difficulties. Exchange rates do not reflect purchasing power parity, and $\$US$ converted into Australian or UK currency will not purchase the same goods and services as it does in the US. Depending upon real incomes, or exchange rate and protection policies, a $\$US$ may buy more or less in other countries. Kravis et al (1978) made estimates of how much use of current exchange rates distorted comparisons of real GDP between countries in 1984. For example, current exchange rates overestimated the goods which could be bought in Australia in 1974—prices of goods in general in Australia were higher than in the US. Kravis et al.'s estimates were updated to the period under review by adjustment
by exchange rate and CPI changes. For example, it was estimated that, in 1980, goods which could be bought in the US for $US1 would cost the Australian equivalent of $US1.36 to buy in Australia. These results are to be expected—high protection and a mineral boom pushed up the value of Australian currency, and in 1980, Sterling was atypically high. Thus the price of the "other" input in 1980 was taken as 1.0 in the US, 1.19 in the UK and 1.36 in Australia. Over time, the price of the "other" input was assumed to vary with the CPI.

Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>U.S.</th>
<th>U.K.</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(1)</td>
</tr>
<tr>
<td>1975</td>
<td>50.9</td>
<td>43.7</td>
<td>41.9</td>
</tr>
<tr>
<td>1980</td>
<td>100.0</td>
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<tr>
<td>1981</td>
<td>112.7</td>
<td>91.2</td>
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</tr>
<tr>
<td>1982</td>
<td>116.2</td>
<td>89.9</td>
<td>86.3</td>
</tr>
<tr>
<td>1983</td>
<td>117.6</td>
<td>86.4</td>
<td>82.9</td>
</tr>
<tr>
<td>1984</td>
<td>116.7</td>
<td>80.7</td>
<td>77.5</td>
</tr>
<tr>
<td>1985</td>
<td>119.7</td>
<td>79.8</td>
<td>76.8</td>
</tr>
</tbody>
</table>

Sources: As described in Text and Data Appendix.

In reality, it is very difficult to know what prices airlines pay for their "other" inputs. In general, the lower the GDP per capita the more official exchange rate conversions underestimate the purchasing power of overseas currency. The UK and Australia, which both had high real exchange rates in 1980 (due to monetary factors, resource discoveries and protection), are exceptions to this rule. It may be objected that airlines do not purchase "goods in general" as inputs, but purchase rather specific inputs, which are, for example, more closely related to wage rates. If so, the corrections, made above, to allow for the price of "other" inputs, would overestimate prices in the UK and Australia. To illustrate the importance of the assumption, input price indexes were calculated on the basis that, in 1980, the price of "other" inputs was the same in the UK and Australia as in the US. In other years, they were assumed to vary with the CPI in the country (see columns (2) in Table 1). Under this assumption, input price indexes in the UK and Australia are lower, by about 4% and 6% respectively.

Certain patterns are evident in Table 1. Input prices, in the 1980's, are higher in the U.S. than in Australia, and higher in Australia than the U.K. Fuel and capital costs are lower in the U.S., but they are more than outweighed by labour costs, which are very much higher. The differences in input costs are more marked if no allowance is made for the price of "other" inputs. Input costs rose rapidly around 1980 (when fuel prices increased dramatically); since 1982 they have stabilised in the
US. This reflects falling fuel prices and labour prices which have shown little movement, perhaps due to the changes in airline markets since deregulation.

Another feature is the volatility of input prices for the UK and Australia, when measured in US terms. This is to be expected when exchange rates alter. The US has been rising against the pound sterling since 1980, and more recently, against the $A. The change in airline input costs has not been as sharp as that in exchange rates, because some airline inputs are tradable. The UK index shows an unambiguous downward trend, at a time of moderate inflation in the UK. It is obvious that comparisons of air fares, using current exchange rates, which do not take into account the trend in input prices would give a false impression.

To illustrate how these indexes might be used, comparisons are made between air fares for a number of years in the 1980's. Economy/Coach fares are compared for 1980, 1983 and 1985 - a choice of years which allows for some variation in exchange rates. Regressions of fares and distance for various trunk routes in the US and Australia, and European cities from London, were estimated. The sample was not scientifically derived - rather it is intended to be illustrative. A regression is a useful method of averaging diverse information - it is not intended here to have any particular explanatory content. Fares in £ sterling and $A were converted into US at the ruling exchange rate. Fares, as well as input prices, were taken at June. The fare equations are given in Tables 2-4. The fit of the US fares gets steadily worse, reflecting the greater divergence of fares coming about since deregulation. The closest fit occurs in Australia, where fares are set according to an almost linear formula based on distance.

The results show considerable variations in relativities over the period. Fares ex the UK are higher than US fares, except in 1985, when short distance (500km) fares are lower. Fares in Australia are generally lower, except for long distance (1000km) fares in 1980. The overall operating efficiency of the airlines involved are likely have change relatively little in the period (all would have experienced some growth in total factor productivity), but the air fares have changed considerably.

As Table 1 shows, input prices have exhibited a similar pattern to air fares over the period. To obtain a measure of performance, it is necessary to relate output to input prices. This is done in the last two lines of Tables 2-4. The air fare equations for Australia and the UK are adjusted by the ratio of US to Australia/UK prices. The results are fare equations which show what the Australian and UK equations would be if their airlines had to pay US input prices. These equations are directly comparable to the US equations. In each case the Australian and UK fare equations are adjusted upward because input prices were lower than US input prices.

One feature to note is that the relativities between US and other countries are much more stable than with the unadjusted
comparisons. They are not completely stable, for a number of reasons. Firstly, relative efficiencies may have changes. Secondly, the response of input prices to changes in exchange rates may not be as rapid as has been implicitly assumed (the price for capital and "other" inputs has been assumed to adjust instantaneously). Thus, airlines of countries which are devaluing will show an improved performance for a period.

However, the major explanation of the changing relativities lies in the altering air fare structures. Between June 1980 and June 1983, the revenue yields and unit costs of airlines such as American (CAB, 1984), yet coach fares, as indicated in Tables 2 and 3 rose significantly. In the US coach fares have risen relative to other fares. The same is true in Australia and the UK (where economy fares rose faster than input costs in a time of increasing productivity) though not to the same extent. These particular tables on their own tell us more about changing fare structures than relative airline efficiency.

Tables 2-4 do indicate that UK-Europe fares, for economy class, are significantly higher than US or Australian fares. Not only are they normally higher in unadjusted terms (until 1985) but UK input prices are lower, and have been falling in $US terms. Australian air fares are slightly lower than US air fares, on an adjusted basis, for short flights, and about the same for longer routes. This is consistent with evidence that Australian airlines are less efficient than their US counterparts (see McKay, 1979 and Kirby, 1984), since the ratio of average to

<table>
<thead>
<tr>
<th>Fare Equations (in $US) - June 1980</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>Distance Coefficient</td>
<td>R²</td>
<td>Fare, 500km</td>
<td>Fare, 1000km</td>
</tr>
<tr>
<td>Australia</td>
<td>12.79</td>
<td>0.089</td>
<td>0.9335</td>
<td>57.29</td>
</tr>
<tr>
<td>(9.963) (10.640)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>94.69</td>
<td>0.168</td>
<td>0.6460</td>
<td>170.69</td>
</tr>
<tr>
<td>(4.529) (9.790)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>54.01</td>
<td>0.045</td>
<td>0.6069</td>
<td>76.51</td>
</tr>
<tr>
<td>(adjusted)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia (adjusted)</td>
<td>13.27</td>
<td>0.92</td>
<td>59.43</td>
<td>105.59</td>
</tr>
<tr>
<td>U.K. (adjusted)</td>
<td>102.14</td>
<td>0.181</td>
<td>132.75</td>
<td>283.36</td>
</tr>
</tbody>
</table>

Note: t values in brackets.
Source: Fares and Distances from ABC World Airways Guides. Adjusted factors from Table 1.

<table>
<thead>
<tr>
<th>Fare Equations (in $US) - June 1983</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>Distance Coefficient</td>
<td>R²</td>
<td>Fare, 500km</td>
<td>Fare, 1000km</td>
</tr>
<tr>
<td>Australia</td>
<td>41.57</td>
<td>0.087</td>
<td>0.8843</td>
<td>85.07</td>
</tr>
<tr>
<td>(2.364) (7.985)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>65.81</td>
<td>0.158</td>
<td>0.9074</td>
<td>144.81</td>
</tr>
<tr>
<td>(4.402) (12.245)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>99.74</td>
<td>0.059</td>
<td>0.4303</td>
<td>129.24</td>
</tr>
<tr>
<td>(4.793) (4.342)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia (adjusted)</td>
<td>47.97</td>
<td>0.100</td>
<td>98.17</td>
<td>148.37</td>
</tr>
<tr>
<td>U.K. (adjusted)</td>
<td>89.57</td>
<td>0.215</td>
<td>197.09</td>
<td>304.61</td>
</tr>
</tbody>
</table>

Note: t values in brackets.
Source: Fares and distances from ABC World Airways Guides. Adjustment factors from Table 1.
Table 4
Fares Equations (in US$) - June 1985

<table>
<thead>
<tr>
<th></th>
<th>Intercept</th>
<th>Distance Coefficient</th>
<th>R</th>
<th>Fare, 500km</th>
<th>Fare, 1000km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>41.85</td>
<td>0.067</td>
<td>0.9033</td>
<td>75.35</td>
<td>109.85</td>
</tr>
<tr>
<td></td>
<td>(3.418)</td>
<td>(8.704)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.K.</td>
<td>61.95</td>
<td>0.113</td>
<td>0.7397</td>
<td>119.45</td>
<td>174.95</td>
</tr>
<tr>
<td></td>
<td>(3.148)</td>
<td>(7.023)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>113.43</td>
<td>0.045</td>
<td>0.2299</td>
<td>135.93</td>
<td>158.43</td>
</tr>
<tr>
<td></td>
<td>(4.578)</td>
<td>(2.960)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia (adjusted)</td>
<td>52.86</td>
<td>0.085</td>
<td>95.17</td>
<td>137.48</td>
<td></td>
</tr>
<tr>
<td>U.K. (adjusted)</td>
<td>92.86</td>
<td>0.017</td>
<td>177.36</td>
<td>262.23</td>
<td></td>
</tr>
</tbody>
</table>

Note: t values in brackets.
Source: Fares and distances from ABC World Airways Guides. Adjustment factors from Table 1.

Economy fares in Australia is much higher than in the US (Trengrove, 1985). It should also be noted that such studies of airline costs make no allowance for the possible higher cost of "other" inputs in Australia than the US, and to this extent, they may overestimate the efficiency difference (the assumption of a high price of "other" inputs makes the performance of Australian airlines appear good).

Fare comparisons such as these can form part of an assessment of how well airlines in different countries are performing. Comparisons utilising one type of fare can be quite misleading, so that evidence needs to be presented on a variety of fares, and importantly, their availability. Coach/Economy fares in the US are now relatively unimportant, whereas they still represent the most used fare in Australia. Evidence on the whole fare structure can be compared using the technique developed here.

Another type of question that can be asked is one of what would fares be like if a particular type of airline, which operates in one country, were to operate in another. For example, what might a "Peoples Express" (no frills, low fare) type airline charge on routes from London, or within Australia. To indicate this, an equation for off-peak fares was estimated for Peoples Express routes in July 1984 (Table 5). Price indexes from Table 1 were used to estimate the fares that such an airline operating from London or within Australia might offer, in US$, given local
<table>
<thead>
<tr>
<th>Fare Equations: Discount Airline and Excursion Fares, 1984 (in $US)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>1. Peoples Express (Off Peak)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>2. Excursion Fare (One Way)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>3. Excursion Fare (One Way) Australia (adjusted to US prices)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>4. Excursion Fare (One Way) U.K. (adjusted to US prices)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>5. Discount Fare Australia (in $US)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>6. Discount Fare UK (in $US)</td>
</tr>
</tbody>
</table>

Source: Timetables, ABC world Airways Guide, June 1984, as described in text.

input prices (lines 5 and 6). A new input price index for Peoples Express was estimated, reflecting the lower labour prices it pays compared to US trunks. (The index was 93.2, as compared to the trunk index of 116.7).

The fares indicate the very lowest available in the US. They are significantly below the excursion fares offered by major airlines in all three countries (lines 2-4). They indicate what might be possible if a similar type of airline were to operate in Australia and the UK, paying local input prices, but achieving the efficiency levels of the US airline. This might not be possible, since employment conditions (for example) may be more restrictive. As against this, however, it is possible that this type of airline would not have to pay the same level of wages as the established airlines. This exercise suggests that fares that are substantially lower than current excursion fares may be possible in the UK and Australia.

It is not possible to use the information presented here to come to any strong conclusions about the performance of airlines in the three countries. Some suggestions can be made. The prevailing view that European economy air fares are high is confirmed. Economy air fares in all three countries, but especially the US, have been rising relative to input costs; air fare structures have been changing. The fares being charged by new entrants such as Peoples Express are indeed low, and cannot be explained entirely by low input costs. If they were similar, equally efficient, similar airlines operating from the
UK or within Australia, paying local input prices, could offer fares considerably below the lowest excursion fares.

To examine the performance question, it is essential to look at the whole fare structure. Economy/Coach fares represent only a small proportion of total traffic in all but Australia. It is, given the data, possible to estimate fare equations for the major fare types, or the average fare, and adjust to obtain valid comparisons. Comparisons can be made of adjusted yields or unit costs, but these are problematical, since they can usually be calculated only for the whole airline, and the nature of the traffic can vary considerably from airline to airline. Calculation of input costs indexes are a necessary first step in making any cross-country price comparisons.

5. Conclusions

International comparisons of air fares can be made, but most that have been made are misleading because they are incomplete. This is so because no allowance has been made for different input prices in different countries. In this paper, an approach is developed which enables valid comparisons to be made. These comparisons can be used in the investigation of questions such as that of the relative efficiency performance of airline systems. The approach has the advantage that it is unaffected by exchange rate alterations. On a negative note, the paper illustrates the degree of inaccuracy with comparisons which ignore input prices.
In 1985, for example, US input prices were over 50% greater than U.K. input prices.

The objective has been to develop and illustrate an approach rather than provide a comprehensive study. To make useful statements about performance, it is necessary to take the air fare structure into account explicitly. This requires evidence on the main fare types, along with the proportion of travellers using them. Attention needs to be given to the actual fares paid, which may be less than the published fares. This is especially true in Europe, where many travellers on European sectors of longer journeys pay fares which are based on, but lower than, economy fares. Allowance also needs to be made for quality aspects, such as seat access. Account must also be taken of the possibility of cross-subsidisation of one region by another both served by the one airline. The exercise of assessing how a specific type of service available in one country might operate in another is a simpler exercise. To be valid, both require measures of input prices.

It should be recognised that fare relativities, adjusted for input prices, are not a complete indication of differential efficiency. There are a number of factors which affect airline performance which cannot be summarised in output characteristics and input prices. Weather and airport congestion effect output, yet they are not under the control of the airline. In some systems, such as in Europe, flights must take more circuituous routes. Thus, in Europe, the elapsed time (according to timetables) required to cover a given distance exceeds that in the U.S. and Australia. Costs are more directly related to elapsed time than distance. These special factors are frequently difficult to quantify, though they should be allowed for in efficiency comparisons.

Recent air fare comparisons, such as those by the CAA (1983) and Trengrove (1985), have taken much more care to allow for output characteristics, such as market density, and fare structures. Evidence on input prices is also required to make comparisons which are useful in assessing performance. The input price indexes presented here constitute a first step, and better information on input prices is desirable. This would include more direct evidence on prices actually paid for inputs, for example, for fuel. Greater disaggregation would also lead to increased accuracy. This is especially true for the category of "other" inputs. More detailed evidence on some inputs, such as airport and air navigation fees is available, but not on many others. Commercial confidentiality, along with the problems of defining, measuring and pricing inputs limits the gains in accuracy that can be made. While perfectly precise measures of airline efficiency are unlikely to ever be possible, improvements in analysis of the input side could be valuable.
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Bureau of Transport Economics (Australia) (1985), "Competition and Regulation in Domestic Aviation: Submission to Independent Review", Occasional Paper No. 72, Canberra, AGPS.


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Data Appendix

(a) Labour
Average remuneration per employee, from International Civil Aviation Organisation (ICAO), various years. Updated to 1984 and 1985 using country wage indexes, from IMF International Financial Statistics.

(b) Fuel
Australia - Prices from Australian Institute of Petroleum data on Aviation Fuel Prices, updated with Department of Transport, Transport Indicators, various years.

U.K. - Fuel use for 1980 estimated from output characteristics, and price estimated from fuel expense (ICAO Financial Statistics) and fuel use. Price in ($US terms) assumed to vary with Middle East Aviation fuel price, from The Petroleum Economist, various issues.

U.S. - Prices to 1983 from CAB statistics on Fuel Price and Use. Updated by assuming price varied according to Middle East price.

(c) Capital

(d) Other

Input Shares

Air Fares

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