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# THE ROLE OF CAPITAL PRODUCTIVITY IN BRITISH AIRWAYS' FINANCIAL RECOVERY

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## ABSTRACT

British Airways (BA) was privatised in 1987, but its financial recovery occurred a number of years earlier. This recovery was sustained throughout the early 1990s economic recession, a period when few major airlines were operating profitably. This paper examines the role of productivity developments at British Airways from the early 1980s through 1996. The emphasis is on capital productivity and investment, but changes in capital intensity and labour productivity are also evaluated.

Various measures are considered for both capital and labour productivity: outputs are measured in available tonne-kms (ATKs) and revenue tonne-kms (RTKs), with the former preferred over the latter two measures, after adjustment for work performed by BA for others. Capital inputs are measured in equivalent lease costs adjusted to constant prices with a different treatment of flight and ground equipment or assets. Labour inputs are derived from total payroll costs deflated by a UK wage price index.

The airline made considerable capital investments over the period and at the same time went through two major processes of labour restructuring. This resulted in a gradual increase in capital intensity, relative high labour productivity growth, but poor capital productivity performance. However, capital investment played an important role in the airline's sustained labour and total factor productivity over the whole period.

## INTRODUCTION

Considerable attention has been given to airline labour productivity, both by researchers and management (see for example Alamdari & Morrell, 1997). Often, the word productivity is used to describe labour productivity with no recognition of the role played by capital and total factor productivity.<sup>1</sup> At the same time, airlines generally emphasise their prowess in technological developments, even though these might not compare as well with other industries as they have in the past.

The airline industry has often been described as capital intensive, although this is somewhat misleading, since labour costs account for up to 35-40 percent of total costs for some airlines, compared to capital costs of 10-15 percent. The capital-intensive label is probably derived from the fact that airlines operate aircraft costing as much as \$150 million each. These aircraft, together with spares

and related flight equipment, account for a very large proportion of an airline's fixed assets.

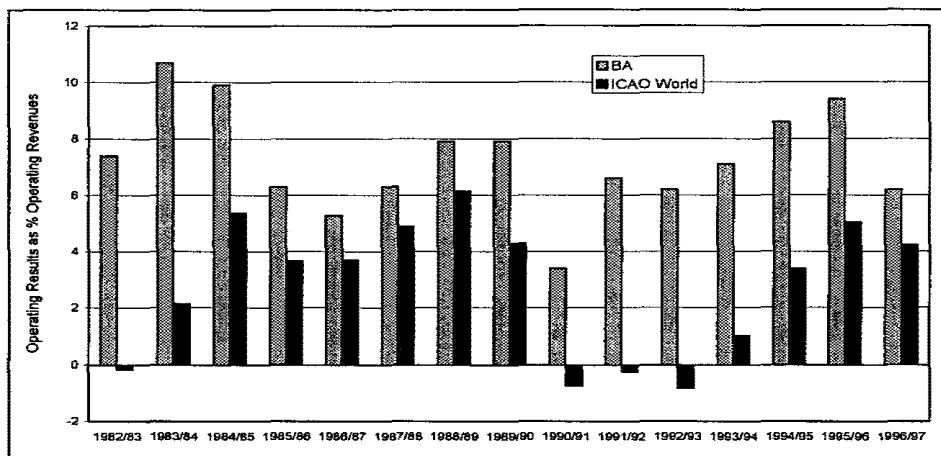
Given the importance of aircraft to an airline's success, much research has been undertaken in the area of technical aircraft efficiency, and some analysis has taken place of aircraft utilisation. However, little work has been published on the relationship between technical efficiency and the intensity of aircraft use on the one hand, and the cost of aircraft and related finance on the other. Some studies have examined total factor productivity and, by implication, capital productivity (see for example, Forsythe, 1985 and Oum & Yu, 1995). But most focus on labour productivity, partly because of trends in the 1970s and 1980s towards overmanning and labour inefficiency, and partly because simple measures can be used with readily available data.

While much attention has recently been applied to labour, there are signs that the airline industry is becoming more capital intensive. In aircraft maintenance, expensive test and monitoring equipment is replacing more labour intensive component repair, while at airports self-service check-in and ticketing machines are becoming more common. In the air, two pilot operations are fast becoming the norm. Capital charges (depreciation, rentals and net interest) increased from 5.6 percent of total costs in 1980 to 11.8 percent in 1995 for British Airways. Capacity costs (depreciation and lease) per ATK for the same airline increased at a compound average growth rate of 8.2 percent a year between 1979 and 1994, compared with 3.1 percent for labour costs per ATK, 1.2 percent for fuel and oil costs, and 3.6 percent for other operating costs.

The purpose of this paper is to examine capital productivity trends for BA pre- and post-privatisation. The analysis covers a period from 1982/83<sup>2</sup> through the privatisation in February 1987 to the early 1990s major economic recession and subsequent recovery in 1996/97. It is of note that BA were one of the few airlines to continue to be profitable throughout the post Gulf War recession (Figure 1). Sustainable airline profitability can only be achieved in the long-term by growth in total factor productivity, which is in turn driven by investment and technical innovation, and it is their achievements in these areas that this paper addresses.

Thus, while the focus of this paper is on the efficiency with which capital is used, this will be considered in the context of total factor productivity, as well as the efficiency with which other inputs were used, notably labour. Just as labour productivity can increase because of the amount of capital equipment used per employee, so will capital productivity depend on the amount of labour employed, staff skills and organisation, as well as technical improvements.

By limiting the analysis to one airline, with a reasonably consistent accounting system over the period adopted, and based largely in one country, problems of comparability are minimised. Furthermore, a time series approach also enables money value to be converted to volume or quantity estimates by means of price deflators or indexes.



**Figure 1. Trends in operating margins: BA vs ICAO World**

The questions to be addressed in this paper are:

- What was the role of capital investment both in BA's pre-privatisation turnaround, and their subsequent strong profit growth?
- How did the airline's capital productivity growth compare with labour and total factor productivity growth?

To answer these questions, a consistent set of data was needed from the early 1980s to the present. These were available from the airline's annual reports, which gave reasonably consistent data for revenues, expenses, assets, the fleet and employees, and where policy changes were made (e.g. in the treatment of leased assets), these were clearly identified in the published accounts.

There have been numerous studies that have evaluated partial productivity measures, and many of these have also considered total productivity in terms of aggregate measures such as operating cost per ATK. There have been some more interesting attempts to provide a meaningful analysis of productivity. An earlier study examined airline managerial efficiency using data for 16 European scheduled airlines, regressing labour productivity against five explanatory variables (Pearson, 1976). One of the variables included in the model was aircraft productivity, defined as average aircraft utilisation. Another equation explained unit costs in terms of four explanatory variables including labour but not capital productivity. Managerial efficiency was then measured by each airline's standardised residuals from the two models. Apart from the lack of rigorous statistical testing of the regression models, this work failed to address marketing efficiency, revenues or quality of output, although the author pointed out this weakness.

Another earlier study focused entirely on labour productivity, examining partial measures for the various airline staff categories for 10 European and North American airlines (McKinsey, 1977). The study concluded that North American carriers had much higher labour productivity in all staff categories, *because of their generally greater size and network density*. This was one of the few studies that adjusted the data for contracting out and contracting in by converting third part amounts paid or received into man-years, although the precise method for doing this was not revealed.

The previous weakness of the omission of marketing efficiency in the Pearson productivity study was rectified in a study of 26 airlines from Europe, North America and the Asia/Pacific regions (Doganis and others, 1995). However, lack of data prevented any adjustments to be made for third party work. The study allows a useful time series and cross-sectional comparison of the world's major airlines, both across and within regions, and includes some disaggregate measures such as pilot productivity.

International differences in capital productivity have been studied very little, according to a recent study (McKinsey Global Institute, 1996), and *'even less is known about what causes capital productivity differences.'* This study's main objective was to identify reasons for capital productivity differences between Germany, Japan, and the United States. It followed on from earlier research into labour productivity and employment performance. The study combined a top-down macro analysis with a micro study of five industries: automobiles, food processing, retailing, telecommunications, and electric utilities.

The McKinsey researchers defined capital input as the flow of services generated from a given stock of capital, rather than the stock itself. This they measured by identifying each type and age of asset, and dividing the cost by the useful life in years. In some cases they also added financing costs to the original purchase cost of the investment goods. Output was measured where possible in physical units (e.g. kilowatt-hours for electric utilities) and value added for industries with more heterogeneous outputs. Inputs and outputs were denominated in local currencies and converted into a common currency by using purchasing power parities (PPPs).

## MEASUREMENT OF PRODUCTIVITY

### Definition of Airline Output

Airline output can be defined in physical or money terms. Physical units most often used in aggregate measures are available tonne-kms (ATKs) or revenue tonne-kms (RTKs). The first describes production or capacity and is relevant to those inputs such as flight operations whose effort is related to this, while the second is a measure of traffic, of greater relevance to sales and handling personnel. Monetary measures of output include total revenue and gross or net value added.

Financial performance measures would clearly relate profit to capital invested in the business. This is not a productivity measure but a measure of financial rather than economic success in meeting the firm's objectives. Its relevance here, however, is the common need to define capital stock or investment.

McKinsey (1996) has a preference for physical measures, but this is not always feasible due both to the difficulty of adding units of a variety of types of output, and also because of quality differences. They also suggest value added or gross output, which overcome both of these difficulties: different types of output can be summed, and higher quality tends to be reflected in higher prices and thus higher revenues or value added. They used value added for all industries except telecommunications (call minutes) and electric utilities (kilowatt hours), where outputs are relatively homogeneous and of constant quality. Value added was defined as factory-gate gross output less purchases of materials and energy. Gross output (also in money terms) was also considered. But both these measures require conversion to a common currency, and this was done using PPPs.

The advantage of monetary measures is that they allow aggregation of both an airline's own services and work performed for others, such as handling and maintenance (see Oum & Yu, 1998). On the other hand, appropriate deflators need to be found for a variety of outputs to accommodate price and exchange rate changes. Physical measures such as ATKs and RTKs record only an airline's own air services, but other services can be converted to equivalent traffic units, as suggested below.

### **Definition of Airline Inputs**

Airlines require inputs of capital, labour, and materials in order to offer flights and associated booking, ground and other services. Inputs, such as airport and air traffic control services purchased from others are themselves the product of capital, labour and materials managed by other agencies.

**Labour.** The simplest measure of labour is average annual employee numbers. This should be adjusted for part-time staff and many airlines publish annual equivalent levels of staffing. Actual man-hours per annum worked would be a better measure, to take into account differences in holiday entitlement, sickness and absenteeism, but this number is not usually available.

The major problem in using equivalent annual employee numbers on the payroll is in its relationship to output. Employees may work on contracts for other airlines and this will not appear in physical measures of output, although it will appear in total revenues under third party work. Conversely, part of ATK output may be produced by employees of other firms, where part of the production is outsourced. This would show up in the cost of services provided by other firms. Both these could be converted into equivalent staff numbers. A recent paper avoided this problem by including incidental revenues in outputs (third party work for other airlines), and material and other services brought in as inputs (Oum and Yu, 1995 and 1998).

Here total payroll costs have been deflated by the UK index of average earnings. Output from BA staff working on services to other airlines has been taken into account above. However, the problem of any significant move towards outsourcing has not been addressed. The only major examples of this over the period studied have been the sale of the engine overhaul business to GE in December 1991. The loss of the third party work provided by this unit would result in a reduction in both outputs and inputs. The distortion arises from a shift of the staff and capital employed in overhauling BA's engines to an outside company, which would reduce only inputs (or transfer them to goods and services bought in), and artificially raise productivity.

**Capital.** The measurement and definition of capital is more complex than labour. The main question is how much capital has actually been consumed over a given period of time?

The stock of capital assets produces a flow or consumption of capital over its useful life. This flow is more appropriate to use as an input of capital, but depreciation is likely to be misleading as a proxy for this, since depreciation allowances are often much greater than the decline in an asset's output producing capacity (Kendrick, 1991). The 1996 McKinsey study highlighted the need to consider monetary values of various capital assets (because of the difficulty in adding physical units of diverse and heterogeneous assets), but converted these to comparable physical units by deflating expenditure-based estimates by the investment goods PPP.

McKinsey considered the flow of service from an asset to be the payments that would be made as if the asset were leased. This would therefore include both depreciation and interest payments. They used this approach for some industries, and for others they divided the capital stock by the useful life for each type of asset, and aggregated these costs to arrive at the total flow of capital services. McKinsey estimated capital stock using the perpetual inventory method. This infers the capital stock from the gross fixed capital formation expenditures and presumed depreciation schedules for each type of asset.

Many authors agree on the inclusion of both depreciation and interest in any measure of capital consumption (see Deakin and Seward, 1969). Some go further to suggest that both dividends and retained earnings should also be included on the basis that, if the return on loan capital investment (e.g. interest) is considered, so should the return on equity capital (Kendrick and Creamar, 1961).

One study converted capital (defined in some way) into equivalent man-years of labour, so that labour and capital could be combined to obtain total factor inputs (Smith and Beeching, 1948)

Another study distinguished between the cost of flight equipment and ground property and equipment (Oum and Yu, 1995). An index of flight equipment input quantity was constructed by multiplying the annual lease cost by the number of each aircraft in the fleet and then weighting the result by the lease

price of each aircraft type. The weighting was performed using the translog multilateral index procedure. The real stock of ground property and equipment was estimated using the perpetual inventory method. The annual cost was then computed by multiplying this real stock by a service price. The latter was estimated using the method proposed by Christensen and Jorgenson (1969). This accounts for interest, depreciation, corporate income and property taxes and capital gains. The flight equipment and ground property indexes were then combined into one index, again using the translog procedure.

## **BRITISH AIRWAYS' CAPITAL PRODUCTIVITY**

### **Output Measurement**

Available tonne-kms (ATK) were initially used as a measure of output, reflecting the total airline production. However, the carrier increased its average load factor consistently over the period, the gains from which would be better reflected in revenue tonne-kms (RTK). The second of the two problems referred to above, namely quality, was not considered to introduce any major distortion. Quality of service has many dimensions, but aircraft types used were broadly similar in terms and increasing length of haul is reflected in ATKs and RTKs. On the other hand, some increases in average frequencies per route may have occurred, and executive lounges in airport became more common.

The first problem, namely the combination of different types of output, was more significant. In 1996/97, non-RTK generating revenues amounted to 751 million, or nine percent of total turnover. These revenues were converted into equivalent RTKs by applying the average yields in each year on BA's own scheduled and charter air services (e.g., 53.1 pence in 1996/97).

Output growth was relatively modest in the earlier part of the 1980s, especially in the restructuring period that was largely completed by 1983/84 (see Figure 2). This involved the deletion of some routes. Faster growth occurred in the period 1986/87 to 1989/90, when the recession set in. This probably finished a year or so earlier in the UK and U.S. compared to other European countries, and growth was resumed in 1992/93 at around 10 percent a year.

### **Input Measurement**

It was shown above that there is no entirely consistent and satisfactory way to measure capital inputs. It was decided, however, that the flow of capital consumed in each year, rather than the stock of capital, would be the best indicator of what was available to provide airline and related services in that year. Similarly, labour wages and salaries provide better indicators of what was available, reflecting hours actually worked rather than numbers of employees, which represent the stock of labour.

Airline capital available consists principally of aircraft, but also of ground equipment, buildings and land. Those that are owned or on finance leases are

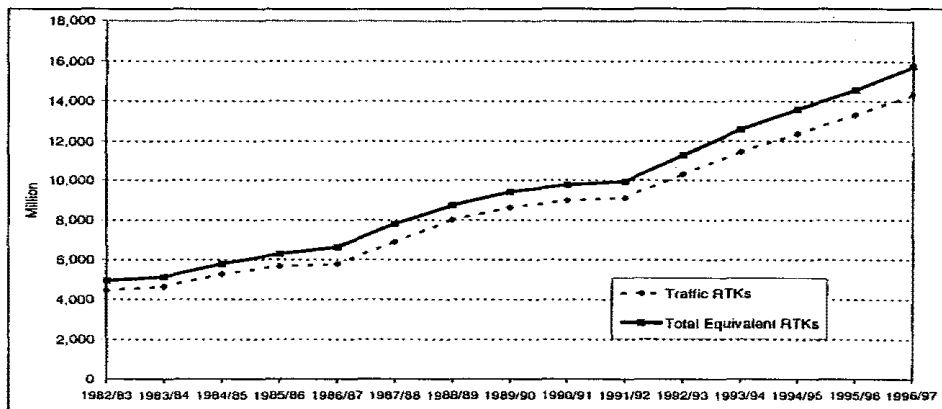


Figure 2. Traffic and total output for BA

depreciated over various service lives in the accounts to give some measure of capital consumed. Capital is also available through shorter term or operating leases, which appear in the accounts as an operating expense, combining depreciation and interest charges. Capital input needs to combine both owned and leased assets into an annual estimate of consumption. This money amount then needs to be deflated to take out any price effects to give a volume indicator of input.

Off-balance sheet aircraft operating leases for BA currently account for just under 30 percent of the total fleet numbers. Rental expenditure for these aircraft gives a good estimate of capital consumption in any year. For owned aircraft, the equivalent lease amount needed to be determined so that total capital input from aircraft could be estimated. This was done by taking the average gross value of the fleet in each year (i.e. before depreciation) and calculating the lease equivalent using the following standard lease formula:

$$\text{Periodic Rental Payment} = PV \div a$$

where: PV = the present value, or equipment cost  
 a = the rental factor, which is:

$$a = \frac{1 - (1+i)^{-(n-x)}}{i} + x$$

where: x = number of rentals payable in advance  
 n = number of payments in lease term  
 i = interest rate per period

The gross fleet value is based on historical costs, updated each year following aircraft withdrawals and additions. For 1996/97, the average gross fleet value was 8.7 billion. These aircraft costs were largely incurred in U.S. dollars and



converted to sterling at end year exchange rates. The lease calculation requires inputs of both remaining service or economic life and interest rate. The former was initially set at 25 years less the average age of the fleet in each year, with the interest rate for each year varying at 50 basis points over LIBOR (London Interbank Offered Rate), or for 1996/97 6.0 percent. This rate of interest is considered the level at which BA would have borrowed, and a variable or floating rate reflected more realistic in relation to both owned and leased aircraft. For lease payments in arrears ( $x = 0$ ), the lease equivalent of the on-balance sheet aircraft amounted to 910 million in 1996/97, to which the off-balance sheet lease aircraft rentals of 119 million were added.

For capital inputs other than aircraft, a lease equivalent was calculated in the same way as for aircraft, but an average remaining life of five years was taken, applied to balance sheet gross asset values. It is likely that the majority of these assets would have been acquired in sterling, so that a UK capital goods deflator would be the most appropriate way to convert value estimates to volumes.

The conversion of these aircraft value estimates to volumes would ideally use a U.S. aircraft manufacturing price index applied to the original U.S. dollar capital costs,<sup>3</sup> and then converted at PPP exchange rates. However, only sterling costs were given, so that a deflator was constructed by converting a U.S.\$ index of aircraft prices to sterling using average /\$ rates of exchange actually applied by BA.

Figure 3 summarises the changes in real inputs over the period studied. It can be seen that after the rationalisation in 1983/84, which continued from the previous year, investment grew over the recovery period to the end of the decade. BA was no exception to the prevailing industry tendency to over-order at the end of a cyclical upswing. However, this was confined to the year 1990/91 when 11 Boeing 747-400s were delivered, together with 5 B767-300s. This was partly

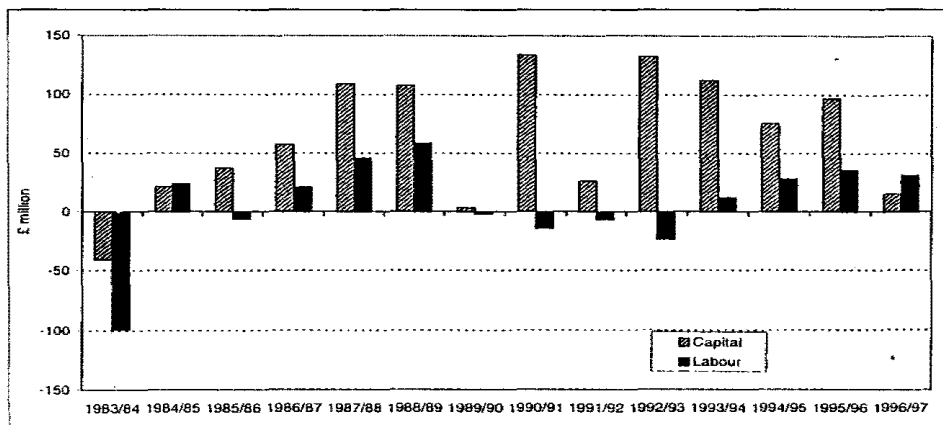


Figure 3. Net real additions to capital and labour for BA

financed by a sale and leaseback on 20 B737-200s; a deal which captured a relatively good average price for these aircraft before it declined.

Average aircraft prices expressed in sterling increased sharply up to 1985/86, mainly as a result of sterling's depreciation (which would have boosted revenues). The converse was true over the next period to 1988/89, when U.S.\$ aircraft prices hardened as a result of increased demand. While prices turned down as a result of the industry's cyclical downturn, by 1996/97 the index had climbed again to its 1990 high point.

Changes in real labour inputs are also shown in Figure 3 for comparison. The large 1983/84 reflects the last year of the major downsizing from 55,000 to 37,000 staff, with modest increases to match the traffic growth in the second half of the 1980s.

### Capital Productivity

An initial idea of capital productivity might be gained from examining trends in average ATKs per aircraft. This ratio does not contain price or value data, but averages efficiency over the whole fleet. A change in fleet mix towards more long haul widebodies would increase the ratio without any underlying change in the true productivity of capital used for supplying a specific city-pair of given stage length. What Figure 4 shows is the tendency over the period of the average price of aircraft to increase faster than average aircraft efficiency, particularly towards the end of cyclical upturns.

In the 1960s and 1970s, new aircraft incorporated a larger number of seats, increased lower deck cargo capacity, and greater speed and range. This inevitably led to easily identifiable and quantifiable efficiency increases delivered in return for some increases in price. Over the past two decades, however, aircraft size has not grown much on average, but many cost saving improvements have

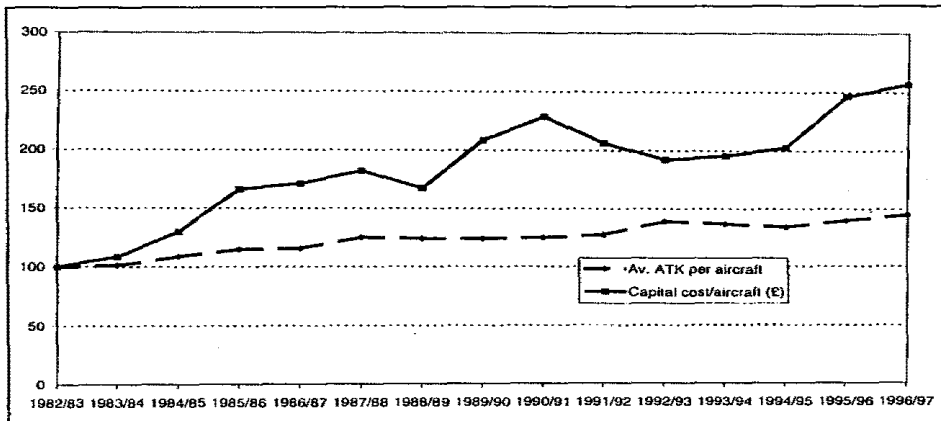


Figure 4. BA aircraft cost and productivity trends

nevertheless been incorporated in the aircraft (e.g., automated flight deck, modular design for lower maintenance costs). The average payload per aircraft in the BA fleet rose from 29 tonnes in 1982/83 to 35 tonnes in 1996/97.

The capital productivity measure described below was adjusted RTK output per total lease equivalent input, deflated by a capital price index. It was concluded that this ratio minimised the key problems discussed in the previous sections. Figure 5 shows that after a rise in the first two years, capital productivity on this basis subsequently declined over the remaining part of the decade, after which it remained stable. The early rise was principally due to an increase in the overall load factors from 61.9 percent in 1982/83 to 67.2 percent in 1984/85. At the same time there was a shift in emphasis from passengers to cargo, the latter utilising spare lower deck capacity. A marked increase occurred in charter flights, especially in 1983/84, which are inherently more capital efficient through high load factors and higher seat density.

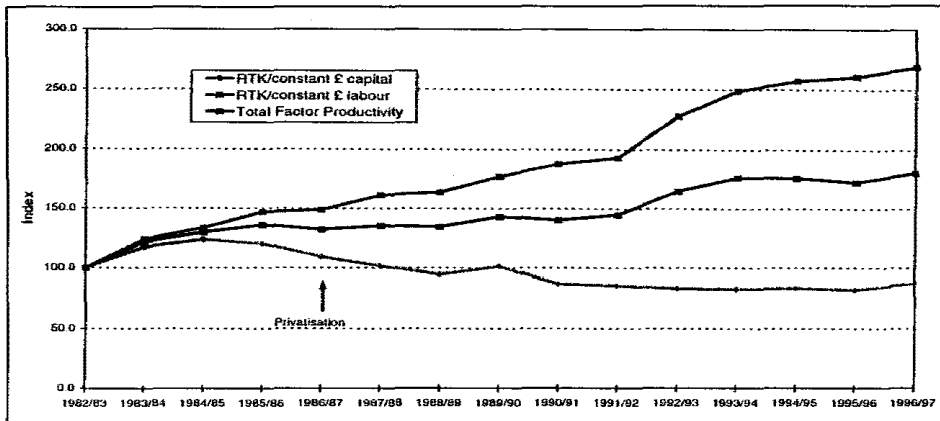


Figure 5. BA capital and labour productivity

The more productive use of existing capital through more efficient organisation or better trained staff is probably difficult to achieve in any sizeable way in the air transport industry. Flying crew are already highly trained and improvements may show up more in better quality service than higher output.

Aircraft accounted for around two thirds of the total annual capital consumption up to 1990/91, but this share subsequently declined to around 60 percent. The faster growth in shorter life investments which are not directly related to aircraft would tend to depress any measure of capital productivity which did not take into account the output quality improvements that such investments tend to produce. This is likely to be the case here, since it has been impossible to incorporate such qualitative changes in the output variable even though they would certainly have affected inputs, especially those of capital.

## Capital and Labour Price Developments

Figure 6 shows developments in output and input prices expressed in sterling terms. The output price index was based on total revenue per RTK. After an increase in the first year, helped by sterling's marked depreciation, it remained stable or drifted down. Airlines had traditionally reacted to a recession by raising fares and sustaining yield increases; however, in the early 1990s recession, competitive discounting led to a decline in local currency yields. For BA this was offset by favourable exchange rate developments, at least against the U.S. dollar, between 1991/92 and 1993/94.

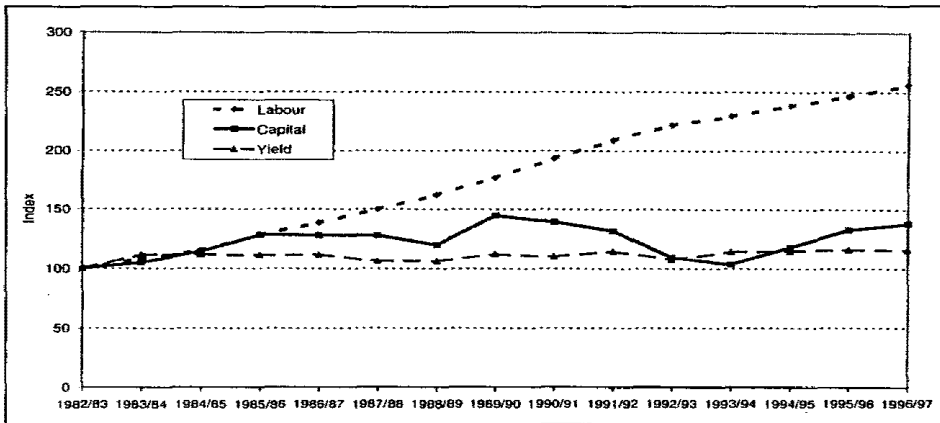


Figure 6. Input and output price indices for BA (£)

Dollar/sterling exchange rate fluctuations also helped dampen down BA's capital input price index expressed in sterling (Figure 7). This was based on Avmark's estimates of the new price of a B757 aircraft. This was an aircraft type that was offered in relatively standard form over the whole period, and was also an important aircraft in the BA fleet.<sup>4</sup> The aircraft price index was combined with LIBOR interest rates, upon which the majority of BA's loans and leases are based, to form an overall capital price index.

The UK index of average earnings was taken as the labour price index, given the largely UK based composition of BA's employees. This rose by an average of 6.6 percent over the period, compared with BA's average staff remuneration per employee of 6.5 percent. Average UK prices rose by 4.9 percent over the period. Survival for BA therefore depended on producing labour productivity gains to allow real pay increases and generate adequate returns to capital and shareholders.

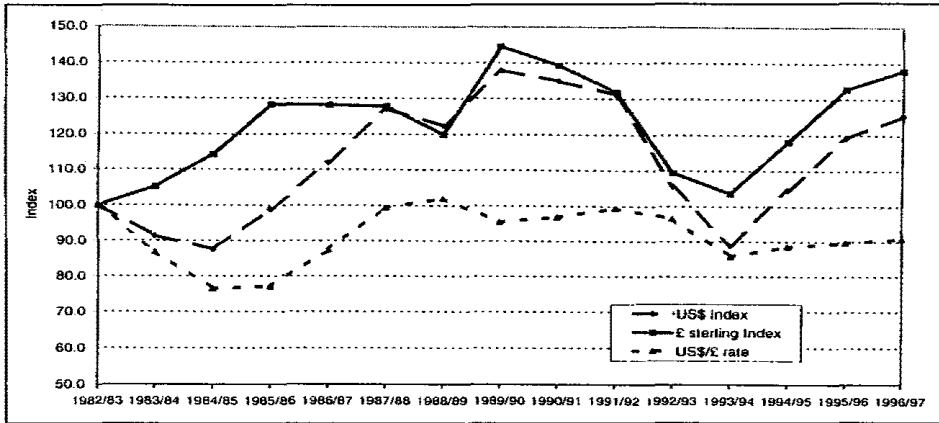


Figure 7. BA capital prices indices and exchange rate

### Labour/Capital Ratio

The capital/labour ratio was around 1.7:1 in 1982/83, but experienced a marked reduction to 1.3:1 by the date of privatisation. This was due to the shake out of labour rather than any planned move towards increasing capital per employee. Once this had occurred, capital inputs tended to rise somewhat faster than labour inputs, with this ratio declining to 1.1:1 by 1996/97.

This suggests that BA, as with many other state-owned carriers, was over-staffed prior to the recovery measures initiated in the early 1980s. This is less likely the case now, although continued labour union power and restrictions in competition (e.g., BA's slot holdings at Heathrow Airport) suggests that some inefficiencies may remain.

A further lay-off of staff in early 1991 as a result of the Gulf War recession might have led to greater capital intensity, but capital was reduced more markedly in that year. This was the result of the withdrawal from all Irish and a number of other routes, and the retirement of seven BAC 1-11s and five Tristar 200s.

What emerges from this analysis is the fact that BA did not achieve any further substitution of capital for labour post-privatisation, even though labour wage rates increased very significantly in relation to capital prices. The extent to which this was possible in any large way in a service industry may have been limited, if the airline were to retain its reputation for high service standards. Some investment in automation led to reduced labour requirements. Examples of this were:

- The replacement of B747-100/200 aircraft which required a flight engineer with B747-400s which did not (from Summer 1989)

- Computerisation in areas such as accounts and management information which reduced staff needs

It is noteworthy that BA's Information Technology budget increased from 35 million in 1982/83, or 1.3 percent of turnover, to 130 million or 2.7 percent of turnover in 1989/90. This was expected to reach five percent of turnover in 1995 (British Airways, 1990). However, many IT or communications applications result in increased service quality rather than greater efficiency. One example of this is issuing passenger service staff with hand-held computers at check-in. It should be added that the air transport industry has been slow to adopt automation in areas such as check-in and ticketing, whereas other industries such as banking have developed faster. Some progress has been held up by the need for industry wide standardisation (e.g., the Automated Ticket and Boarding pass, and electronic ticketing). This is because of the continued importance of interline sales.

### **Key Factors in BA's Recovery and Above Average Financial Performance**

From the discussion above it was evident that labour productivity was the principal agent of BA's recovery, as well as its above average performance during the recession in the first half of the 1990s. Sterling's large fall, at least against the U.S. dollar, also helped over the recovery period to 1984/85.

For the period as a whole, capital productivity by itself only contributed to the recovery between 1982/83 and 1984/85 and, for the rest of the period, growth in capital inputs exceeded output growth. This was partly because additions to capital tended to be aircraft of similar capabilities and size to existing aircraft. The benefits from these aircraft came from qualitative improvements, which could not be allowed for in the output index used in this paper. For example, more overhead locker space, improved seating, or lower cabin noise might have improved the yield from a similar volume of traffic. Non-aircraft investments, which grew faster than aircraft investment after 1992, would also have given the airline a qualitative advantage.

However, capital investment also enables the airline's staff to be more productive. BA's total lease equivalent capital per employee increased in real terms from 5,100 in 1982/83 to 19,860 in 1996/97. This by itself would have been a major reason for the airline's success in increasing labour productivity.

Total factor productivity (the weighted average of labour and capital productivity) was shown in Figure 5 to have increased by just under 30 percent up to privatisation in early 1987. A further 30 percent advance occurred between 1991/92 and 1996/97, again driven by labour productivity achievements. BA's total factor productivity based on the above measures increased at an average rate of 3.4 percent a year between 1986 and 1995 compared with other research which estimated an identical rate for seven of the largest EU airlines over the same period (Oum & Yu, 1998). This is surprising, given that the same study reported a decline in TFP between 1990 and 1992 for the EU airlines, whereas

BA was shown here to have increased productivity by 20 percent over these three years of recession.

The productivity of inputs other than labour and capital should also be mentioned, although this paper has not focused on these. Fuel and airport/ATC services are probably the two most important. The latter have increased in price substantially over the period, with little scope for increased efficiency, except by using larger aircraft, which was not the case. Fuel efficiency increased gradually over the period, as new aircraft were introduced. However, the fuel price declined significantly over both the first half of the 1980s and the 1990s largely taken as a whole. BA benefited from this in its pre-privatisation period, even after taking into account the weaker U.S.\$ exchange rate. The same was the case in the early 1990s, although the exchange rate did not decline as much.

### ENDNOTES

1. For example, Air Canada in its 1997 Annual Report, p. 33.
2. The second complete financial year following the appointment of Lord King as Chairman.
3. The majority of BA's aircraft are U.S. built, although some have UK manufactured engines. A price index based on the manufacturer's labour and materials cost is normally used in the aircraft purchase contract to escalate the agreed price to a delivery year value.
4. BA's B757s increased from 4 in April 1993 to 41 in April 1997.

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