AN ECONOMIC PERSPECTIVE OF AUSTRALIAN INTERNATIONAL CIVIL AVIATION POLICY

by

CHRISTOPHER C. FINDLAY

A thesis submitted for the degree of Doctor of Philosophy of the Australian National University

March, 1982
The work of this thesis is my own.
Dedicated to the memory of my mother's example and inspiration.
ACKNOWLEDGEMENTS

My first debt is to my supervisor, Peter Swan. He suggested the topic in 1977, encouraged me to develop an early paper into this thesis and, during its progress, cheerfully provided incisive comments.

Other people provided considerable assistance. Two other workers on aviation policy in Australia, Peter Forsyth and the late Robin Hocking, were always generous with time for discussion and advice and with references. I benefitted from the responses of my Ph.D. student colleagues at a number of Ph.D. workshop talks I gave during the course of this work. In particular, I benefitted from the comments of Ian Harper and Michael Kirby. Faculty members provided assistance on different parts of the work. In particular, I would like to thank Robert Albon, George Fane, Ted Sieper and Neil Vousden.

I am grateful to the ASEAN-Australia Economic Relations Research Project for sponsoring some of the work and for making it possible for me to discuss aviation policy with a large number of airline executives and policy makers. I am grateful to those people for their time and interest. Thanks especially to Peter Drysdale and Ross Garnaut for encouragement.

Officers of the Department of Transport, Australia and the Bureau of Transport Economics willingly provided data and advice on the policy mechanisms. I am also grateful for the comments of members of Qantas' management.

Finally, special thanks go to my friend Tania.
This thesis provides an economic perspective of Australian international civil aviation policy. It examines the effects of the current regime, considers motives for intervention in air transport markets and compares policy options. The broad conclusion is that public interest objectives could be pursued more cheaply by a new policy, a combination of 'open skies' with explicit subsidies where necessary.

The characteristics of Australian regulation have been control of entry, capacity and prices. Recently price control has been relaxed. Another feature of Australian policy has been government ownership of the flag carrier, Qantas. The mechanisms of the policy include a series of international bilateral agreements supported by domestic legislation.

The emphasis in this thesis is that the entry barriers imposed by this regulation have raised the costs of international air transport and imposed a deadweight cost on the community. Removal of these barriers would lead to a substantial gain, the size of which is estimated here. This result is the foundation of the broad conclusion of the thesis.

A number of objections to competition in this industry have been made. These are examined in the thesis. Some are found to be not relevant to civil aviation; examples include service quality and market structure arguments. Others could apply to this industry. Examples include the defence externality claimed for air
transport. Conditions in which the externality argument is relevant are identified but it is emphasised that the benefits claimed could be achieved more cheaply than at present.

An interesting objection to 'open skies' is the view that unilateral action is impossible. By this view, a noncooperative approach, characterised as competition, is not possible and cooperation, like the current regime, is required. On the contrary, it is argued here that the current regime is actually the outcome of non-cooperative behaviour and that a different type of cooperation is required for further welfare gains.
# TABLE OF CONTENTS

## PART I. INTRODUCTION

<table>
<thead>
<tr>
<th>Chapter 1</th>
<th>Introduction</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 2</td>
<td>Characteristics of Australian Regulation</td>
<td>6</td>
</tr>
<tr>
<td>2.1</td>
<td>Subsidy for domestic mail routes</td>
<td>6</td>
</tr>
<tr>
<td>2.2</td>
<td>Outline of the Qantas Story</td>
<td>6</td>
</tr>
<tr>
<td>2.2.1</td>
<td>Subsidy for domestic mail routes</td>
<td>6</td>
</tr>
<tr>
<td>2.2.2</td>
<td>International services</td>
<td>8</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Nationalisation</td>
<td>10</td>
</tr>
<tr>
<td>2.2.4</td>
<td>Summary</td>
<td>15</td>
</tr>
<tr>
<td>2.3</td>
<td>International Air Traffic Agreements</td>
<td>16</td>
</tr>
<tr>
<td>2.3.1</td>
<td>National sovereignty</td>
<td>16</td>
</tr>
<tr>
<td>2.3.2</td>
<td>British Commonwealth views</td>
<td>17</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Chicago convention</td>
<td>19</td>
</tr>
<tr>
<td>2.3.4</td>
<td>Air services agreements</td>
<td>21</td>
</tr>
<tr>
<td>2.3.5</td>
<td>Australian legislation</td>
<td>24</td>
</tr>
<tr>
<td>2.3.6</td>
<td>Commercial agreements</td>
<td>24</td>
</tr>
<tr>
<td>2.4</td>
<td>Recent Changes in Australian Policy on the Kangaroo Route</td>
<td>25</td>
</tr>
<tr>
<td>2.4.1</td>
<td>Market pressure</td>
<td>25</td>
</tr>
<tr>
<td>2.4.2</td>
<td>ICAP</td>
<td>29</td>
</tr>
<tr>
<td>2.4.3</td>
<td>Assessment of ICAP</td>
<td>32</td>
</tr>
<tr>
<td>2.4.4</td>
<td>Recent policy change</td>
<td>35</td>
</tr>
<tr>
<td>2.5</td>
<td>Summary</td>
<td>37</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Model of an Air Transport System</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Strotz' Parable</td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Special Case of the Utility Function</td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>Market Results</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>Strotz' Parable Illustrated</td>
<td></td>
</tr>
<tr>
<td>3.6</td>
<td>Conclusion</td>
<td></td>
</tr>
</tbody>
</table>

**PART II MOTIVES FOR INTERVENTION**

<table>
<thead>
<tr>
<th>Chapter 4</th>
<th>The Service Quality Case for Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>4.2</td>
<td>The ICAP Ideal</td>
</tr>
<tr>
<td>4.3</td>
<td>The ICAP Arguments</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Capacity and utilisation</td>
</tr>
<tr>
<td>4.3.2</td>
<td>On-demand service</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Fare structure</td>
</tr>
<tr>
<td>4.4</td>
<td>Conclusion</td>
</tr>
</tbody>
</table>

**Appendix to Chapter 4** Estimating the Cost of Delay

<table>
<thead>
<tr>
<th>Chapter 5</th>
<th>Rent Seeking</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>5.2</td>
<td>The Model</td>
</tr>
<tr>
<td>5.3</td>
<td>Unilateral Regulation</td>
</tr>
<tr>
<td>5.4</td>
<td>Retaliation</td>
</tr>
<tr>
<td>5.5</td>
<td>Cooperative Bargaining</td>
</tr>
<tr>
<td>5.5.1</td>
<td>Introduction</td>
</tr>
<tr>
<td>5.5.2</td>
<td>Equal costs per flight</td>
</tr>
<tr>
<td>5.5.3</td>
<td>Unequal costs per flight</td>
</tr>
</tbody>
</table>
5.6 Determination of Shares
  5.6.1 Introduction
  5.6.2 Profit sharing
  5.6.3 No profit sharing
5.7 Application of Results
  5.7.1 Pervasiveness and persistence of regulation
  5.7.2 Impossibility of unilateral action
  5.7.3 Characterisation of regulation

Chapter 6 Market Structure, Foreign Exchange, Defence and other Externalities
  6.1 Introduction
  6.2 Market Structure
  6.3 Defence and Other Externalities
  6.4 Foreign Exchange
  6.5 Risk
  6.6 Summary

PART III AIR TRANSPORT COST FUNCTION
Chapter 7 Cost of Output of Regulated Firms
  7.1 Introduction
  7.2 Managerial Model
    7.2.1 The model
    7.2.2 Implications for X-inefficiency
    7.2.3 Welfare implications
    7.2.4 Managerial labour markets
7.2.5 Government versus private ownership
7.2.6 Other input suppliers
7.3 Summary

Chapter 8 A Cost Frontier for Civil Aviation
8.1 Introduction
8.2 Estimation Method
  8.2.1 Introduction
  8.2.2 Variable cost function
  8.2.3 Functional form
  8.2.4 Estimation of the frontier
  8.2.5 Measuring output
  8.2.6 Statistical method
  8.2.7 Pooling data
  8.2.8 Summary
8.3 Results
8.4 Applications
  8.4.1 Scale economies
  8.4.2 Elasticities of substitution and demand
  8.4.3 Government ownership
  8.4.4 Frontier cost function
  8.4.5 Results for Qantas
  8.4.6 Minimum cost operator

Appendix to Chapter 8 Data Sources
PART IV POLICY OPTIONS AND COSTS

Chapter 9 The Cost of Regulation

9.1 Introduction 201
9.2 Model of Regulation 201
9.3 The Consumption Cost of Regulation 203
  9.3.1 Definition 203
  9.3.2 Change in the money fare 209
  9.3.3 Change in the cost of delay 213
  9.3.4 Consumer evaluation 215
9.4 Adjustments and Qualifications 222
  9.4.1 Loss to Australian consumers 222
  9.4.2 Rents to factor owners 228
  9.4.3 Other adjustments 231
9.5 Summary 232

Appendix to Chapter 9 Qantas Cost of Capital and Profitability 233

Chapter 10 Policy Options and Summary

10.1 Introduction 247
10.2 Sale of the Flag Carrier 247
10.3 Deregulation of Capacity 249
10.4 Deregulation of Fares 253
10.5 Open Skies 256
  10.5.1 Introduction 256
  10.5.2 Subsidy equivalent 258
  10.5.3 Operation of the subsidy policy 261
  10.5.4 Conclusion 267

REFERENCES 268
CHAPTER 1: INTRODUCTION

This thesis reports an economic perspective of Australian international civil aviation policy. Predictions are made of the effects of the policy and estimates of the size of these effects are reported. Motives for intervention in air transport markets are critically reviewed and a number of policy options are compared. The broad result is that the current regime is costly and that public interest objectives could be pursued at less cost by a new policy, a combination of 'open skies' and explicit subsidies where necessary.

The method employed is to first describe the features of regulation. Then a model of air transport markets is developed. The model can be used to predict the outcome of competition, the effects of regulation and the characteristics of optimality. This model provides a theme to the thesis. Critical parameters are estimated using econometric methods and the results are applied in estimation of the cost of intervention and the review of policy options.

The first part of the thesis contains the introductory material of precise definition of the scope of the topic (this Chapter), description of the development and characteristics of current policy (Chapter 2) and the main model of an air transport system (Chapter 3). The second part reviews the motives for intervention. These include service quality (Chapter 4), rent seeking (Chapter 5) and a number of other externality and market structure arguments (Chapter 6).

The third part reports a model of the performance of the regulated firm (Chapter 7) and an estimate of a cost function for
air transport (Chapter 8). This estimate is a valuable input in the welfare analysis of the fourth part in which the estimate of the welfare cost of the current regime is reported (Chapter 9) and policy options are reviewed (Chapter 10).

Briefly, this thesis is a study of industry policy, estimation of the cost of the current regime and comparison of policy options.

One question is considered here but not answered in detail. This question is begged by the main result of the work reported. If there is a 'free lunch' in moving to competition why has it not already happened? There is a number of competing hypotheses.

First, there is a group of public interest models. One type is that intervention occurs to correct a distortion, such as the presence of an externality. Examples of this type of public interest argument are examined below but this type does not help answer the question posed about the persistence of the current regime. Another type of public interest theory is that regulation was initially imposed in error (Levine, 1981). Having been introduced, regulation could have created an interest group which would lose by its removal. As a result, even if the error is recognised, there will be resistance to change. Branches of this theory could include the capture theory, that regulation was initially in the public interest but the policy has since been dominated by private interests (see Posner (1974) for a review). Another branch could be that regulation was genuinely in the public interest at its inception but since then conditions have changed so that it is no longer relevant. Its persistence could, once again, be explained by the interest groups it has created.
Discussion of the role of private interests in models where the original motivation was public interest leads to the second group of theories of regulation, the private interest theories (see Stigler (1975) and Peltzman (1976)). Regulation occurs to transfer wealth from large but disorganised groups, like consumers, to smaller and more politically powerful groups, like producers, factor owners or even a localised group of consumers. Within this group there is a number of threads (reviewed by Levine (1981)) which are not gathered here.

Examination of regulation of international civil aviation suggests a reason for the persistence of regulation which is not pressure from private interests, emphasised so far. In this model, regulation initially occurs in the public interest, taking a parochial view, in order to extract rents from foreigners. The foreigners, however, respond in-kind to this tax imposed on them and the result is pervasive and persistent regulation of the kind now observed (see Chapter 5 below). The main reason for persistence is that no country trusts others not to reimpose the tax of regulation if it were to relax its regulation. Within this type of regulation, the private interests of factor owners in the industry can easily be served; for example the pricing rules used can create rents for these people. Thus an additional constraint on removing regulation would be their opposition. The primary reason for persistence remains mutual international mistrust but, at the same time, private interests, perhaps not only factor owners but also particular consumer groups, could influence the operation of the policy.

The private interest and mutual mistrust explanations of the persistence of regulation tend to be difficult to distinguish (see
Posner (1974) for discussion of testing public and private interest models). However, each model does have some unique characteristics and examples are given below. It is also possible to offer contrasting explanations of recent events in the development of international policy derived from both a public interest model, which often contains some error on the part of the regulators, and from the model which emphasises private interests. The existence of these unique characteristics and of the different types of explanations of recent events suggest some tests of both the original motive for regulation and the criteria by which current decisions are made by regulators. These tests have not been pursued in this thesis. The view is taken that private interests probably had some weight in the formation and operation of regulation but their weight has not been determined. To do so would require another project of similar scale. Even though these tests are not completed, there is a model of regulation implicit in the choice of topic and content of the thesis. It is that more information on the costs of the current regulation and its alternatives must have some effect on the choice of future policy, even if private interests are influential; in support, Levine (1981) suggests that scholarly work on the U.S. industry contributed to the decision to deregulate.

In summary, the question of the source of regulation and influences on its operation are raised but conjectures made are not tested here: these conjectures suggest a program for future research in the economics of regulation in this industry. Another group of questions is not considered at all. For example, the thesis concentrates on passenger transport and ignores freight. The question of whether air transport should be regulated to improve
safety is not examined. Implicitly the view is that safety objectives can be achieved by technical regulation, which is outside the scope of the thesis.
CHAPTER 2: CHARACTERISTICS OF AUSTRALIAN REGULATION

2.1 INTRODUCTION

This chapter contains a brief description of the development of the Australian flag carrier Qantas and international negotiation of fares and flight frequencies on routes to Australia. The operation of regulation in recent times is also examined, by describing developments on one route, the Kangaroo route (to the UK) since the early 'sixties. This material provides evidence of the motives used to justify both the existence of regulation, and its form. The discussion permits a characterisation of regulation which can be examined in depth using more analytical methods.

2.2 OUTLINE OF THE QANTAS STORY

2.2.1 Subsidies for domestic mail routes

The Queensland and Northern Territory Aerial Services Ltd. (Qantas) was formed in 1920 by two ex-war pilots, and two Western Queensland graziers. The aim of the company was to establish an air transport service linking rail termini in Queensland with Darwin in the Northern Territory. One of the founders of Qantas, Hudson Fysh, said 'only a regular subsidised service would save us' (Fysh, 1965, p.112). The company had to lobby the Federal Australian government to decide in favour of a subsidised service in Queensland and then, when the government agreed, bid for the service in an open tender market. Qantas won its first contract, and regular flights by the company began, in 1922. From that date, the company extended its network in Queensland and the Northern Territory (Fysh, 1965).
Hocking and Haddon-Cave (1951) point out that civil aviation received government assistance in the 'twenties from both government provision of ground facilities and from direct subsidies. The subsidies before 1940 were mostly paid on the basis of miles flown. A condition of the contract between the government and the subsidised airline was that airmail be given priority over freight and passengers. Hocking and Haddon-Cave argue that these payments were the main portion of the revenue of the subsidised carriers like Qantas, although not so important for carriers operating in the well populated areas where passenger demand was greater.

Hocking and Haddon-Cave argue that some qualification needs to be made to the description of these payments to airlines as 'subsidies'. They were actually payments collected by the Department of Civil Aviation (DCA) from the postal services (the Postmaster-General's Department) and distributed to airlines with which the DCA had contracts. In other words, DCA was an intermediary, administering air mail contracts. After 1940, the payments on large contracts were made on the basis of the volume of mail carried, so the payments could be interpreted as fees paid by consumers for better quality postal service. But on other routes, the payment was still per mile flown. On these latter routes, which Hocking and Haddon-Cave point out were outback services, the payment could be described as a 'subsidy'. Hocking and Haddon-Cave (1951, pp.122-3) also point out that only half the airmail revenue paid by the postal service to DCA was actually passed directly to the air transport industry. The balance, presumably, would have been absorbed, not only by DCA administration costs but also by the cost
of provision by DCA of facilities complementary to air transport.\footnote{No fee was charged for air navigation aids and landing fields until 1947 (Hocking and Haddon-Cave, 1951, pp.126-134). A more efficient procedure would have been to expose all aviation consumers to these fees and for the Postmaster-General to directly offer contracts to the airlines. There is no explanation, on efficiency grounds, of why the DCA was used as an intermediary.}

In summary, the picture of government intervention at this stage was that postal service consumers were taxed and the revenue used to subsidise postal services to other (outback) consumers and to subsidise the other outputs of civil aviation.

There was, however, another constraint on aviation policy. A policy in the early 1920's was that airmail contracts were not offered on routes parallel to railway lines. For example, on the trip from Normanton to Brisbane, the first leg to Charleville (800 miles) was flown by Qantas but the last leg (300 miles) had to be completed by train (Hocking and Haddon-Cave, 1951, p.84). The policy of the 'twenties can be interpreted as providing communication for outback people but with the constraint of protecting the railways. This constraint was later relaxed when plans were made to link the domestic network to international routes.

\subsection*{2.2.2 International Services}

Hocking and Haddon-Cave (1951, p.17) report that a policy agreed at the Imperial Conference of 1926 was to develop air communications between members of the British Commonwealth. The entry point to Australia was regarded as Darwin and the Australian government planned to develop domestic routes to Darwin to join international services. This plan suited Qantas which was already flying from Eastern Australia to Darwin.
A government interdepartmental committee was formed in 1931 to examine the development of airmail services between London and Australia. It recommended an Australian company operate a service to join that provided by the British international operator (Imperial Airways). But the committee was not opposed to service by an Australian company in which Imperial had a share. Qantas and Imperial formed such a company in 1934. The new company was called Qantas Empire Airways (QEA) and it won the airmail contract for the Singapore-Brisbane service, via Darwin, later that year.

Acceptance of the QEA bid meant rejection of a Dutch offer to provide an airmail service by extending routes from Amsterdam to Indonesia. The Dutch, according to Hocking and Haddon-Cave, could offer a cheaper and faster service (p.86). The Dutch offer was rejected because the interdepartmental committee thought that, for defence reasons, control should remain in the hands of members of the British Commonwealth. There was conflict between Australian and British interests, since the latter wanted to control the route all the way to Darwin. Australia insisted on flying the Singapore-Darwin leg because, according to a statement by the Minister of Defence at the time (quoted by Hocking and Haddon-Cave (1951, p.87)), the route had value for defence; Australian pilots would become familiar with the waters and islands over which the route was flown.1

It appears there were considerable costs involved in using QEA and Imperial, instead of the Dutch carrier. First, the Dutch

---

1 Again in 1935, the British proposed Imperial operate the Singapore-Darwin sector but the Australian government was determined, according to Hocking and Haddon-Cave (1951, p.89) to preserve that leg for an Australian operator, in particular, for QEA.
offer would not have required a subsidy and the Auditor-General, in reports quoted by Hocking and Haddon-Cave, said Australia 'could not afford' the England-Australia airmail service. Secondly, the Imperial-QEA trip time was longer than the Dutch time. The reason was that the Dutch had faster aircraft but also the route flown by the Imperial-QEA system was circuitous. Their route had to continue to meet 'the needs of the people of the sparsely settled portions of the Commonwealth to whom air-transport has proved such a blessing' (according to the Australian Minister for Defence, quoted by Hocking and Haddon-Cave (1951, p.88)). This argument was applied to sectors within Australia and in other countries of the British Commonwealth.

2.2.3 Nationalisation

2.2.3.1 Events of 1946 and 1947: A number of major changes were made on the route to the UK since its inception. The changes included rerouting during the war and the use of different aircraft on the route. But the next major event of interest here was the nationalisation of QEA.

By this time, QEA had become the 'chosen instrument' of the Australian government in international civil aviation (Hocking and Haddon-Cave, 1951, p.89). Governments at this time tended to designate one carrier as their instrument (for example, Pan Am in the US and Imperial in the UK). Corbett (1965, pp.20-1) argues the reason was that airlines needed government backing to negotiate landing rights in other countries (see Section 2.3.1) and, in return, governments concerned with defence and prestige sought to use the airline as a policy instrument. This policy was made more effective by choosing just one carrier, which might be subsidised to
compete against foreign governments' carriers. Taneja (1980) offers a similar explanation for the 'chosen instrument' policy.

The British government had nationalised Imperial in 1939 and created BOAC, which then held the British 50% share in QEA. In 1946, the Australian government acquired the BOAC share. This purchase was described as non-controversial by Corbett (1965, p.95) since the Parliamentary Opposition 'raised no objection'. The context of the purchase was that at a British Commonwealth meeting after the war, it was agreed that international services should be joint national operations. Since QEA was the Australian chosen instrument, joint national operations then meant a parallel service by BOAC and QEA. The Australian government thought it was inappropriate that BOAC and, through it, the British government should own half the airline providing the Australian share of the service so it bought the BOAC share.

In July 1947, the Australian government also bought the remaining 50% interest in QEA held by Qantas. This purchase was more controversial. The cases made for and against complete nationalisation are discussed in the next section.

2.2.3.2 Arguments about Nationalisation: 'Generally', said Prime Minister Chifley, 'it is better that (international civil aviation)

1 An Opposition spokesman used these words in commenting on the Qantas Empire Airways Agreement Bill, 1946, a bill authorising government purchase of QEA shares (see Commonwealth of Australia, Parliamentary Debates (hereafter Hansard), House of Representatives (hereafter HR), 6 December 1946, p.1153).

2 This reason was given by the Minister for Civil Aviation in his second reading speech to the QEA Agreement Bill (see Hansard, HR, 4 December 1946, p.972).
undertakings should be controlled by governments'.¹ This view of the leader of the Labor government of the day reflected the Labor party's dogma, the socialisation objective. Crisp (1977, p.250) reports that Chifley subscribed 'positively and actively' to this objective and Corbett (1965, p.47) lists 9 major public enterprises formed by the Chifley government between 1944 and 1949 and a number of other commissions and regulatory bodies. While Crisp also reports Chifley had no intention of nationalising 'things which did not matter' (p.251) there were a number of reasons the Labor government regarded international civil aviation as important enough to nationalise. Some of these are now discussed and, later, the Opposition's reaction is reported.

First aviation was important because of its contribution to national development. This type of argument was reported by Corbett (1965, p.86) to have been used by Civil Aviation Minister Drakeford in favour of nationalisation of domestic airlines. The argument can be interpreted as the presence of positive externalities in civil aviation which private operators will not take into account so the sector will be too small. Presumably, a policy of subsidising aviation, used in the past, could have had the desired effect. Hocking and Haddon-Cave (1951) suggest that nationalisation was favoured because a degree of public control was seen as desirable if public subsidies were to be paid, which was believed not possible under private ownership. Similarly, it was argued that nationalisation would increase the defence value of civil aviation because coordination of civil and military operations would be facilitated. Essentially the problem can be reinterpreted as

¹ Hansard, HR, 3 June 1947, p.3244.
monitoring the performance of the subsidised firm. Hudson Fysh, discussing the creation of another government owned firm (TEAL, (see below)), said that governments were wary of operators who 'unduly exploit a subsidised concession. Australia had tried the tender system to its cost, and was not going to be led up that garden path again' (Fysh, 1968, p.106). No examples are given of these "costs".

Another reason, which Corbett argues was crucial in the case of domestic aviation (p.86), was that the Labor party was opposed to international shipping companies and other 'private interests' having a hand in aviation. A competitor for QEA for international routes, Australian National Airways Pty. Ltd., had shipping companies as its main shareholders. The Labor party suspected these companies of wanting to restrict the development of aviation in Australia. The party's (implicit) model must have been that of a monopolist of the two modes maximising the combined profit from each market. The Labor party suspected Imperial Airways of trying to control international aviation to Australia through the agency of local 'private interests' (Hocking and Haddon-Cave, 1951, p.87). Both these views imply that the market was capable of being monopolised. In other words, these arguments for nationalisation can be reinterpreted as avoiding the costs of another type of market failure, due to a non-competitive structure.

Another reason for complete nationalisation, emphasised by Hudson Fysh, then QEA managing director (Fysh, 1970, p.41) (and by Chifley)¹ was that without government ownership Qantas could not finance its development. This argument seems to be that Qantas

¹ Hansard, HR, 3 June 1947, p.3244.
needed government guarantees to raise funds on world capital markets. Another aspect of the capital market case for nationalisation, also made by Fysh, was that the benefits of the government guarantees that could be created by nationalisation should not be restricted to current shareholders. 'This ... would have been too much for the Government to accept' Fysh said (1970, p.43). It is not clear why these benefits, presumably a reduction in risk, would not have already been capitalised into the share price. Fysh also argued that there would have been inevitable argument over financial policy, including dividend rates.

Hocking and Haddon-Cave (1951, p.107) emphasise another aspect of financial negotiation as a reason for nationalisation. In this case it was negotiation between BOAC and QEA over the terms of the joint service on the Kangaroo route. They report an argument that negotiations would be simpler if both carriers were completely government owned.

These are the arguments for nationalisation, made at the time and relevant to international civil aviation. The Opposition reacted vigorously to the decision to buy Qantas' share of QEA. A spokesman (Mr White) said the purchase was 'quite unnecessary, and was incurred solely because of the government's obsession to nationalise, or socialise, everything!'1 The same spokesman had earlier supported the government purchase of the BOAC share of QEA. He had then said that the initiative and ability of the QEA management would have the 'backing of the nation's resources' and the partnership 'should function satisfactorily'.2 But he argued

1 Hansard, HR, 21 October 1947, p.1005.
2 Hansard, HR, 6 December 1946, p.1153.
that complete government ownership, meaning government control, would lead to a decline of efficiency and losses.\(^1\) The government decided to maintain the corporate form of QEA and to leave the management of the company intact; Corbett argued that these decisions took most of the bitterness out of arguments over nationalisation (p.96), and could be interpreted as an attempt to take account of the inefficiency criticism of government ownership.

2.2.4 Summary

Since its creation in 1920, Qantas changed from a contracted mail carrier in Western Queensland to QEA, a government owned firm and the 'chosen instrument' of the Australian government in international civil aviation. The path, and result, of that development was affected by a number of factors. These included public interest types of argument for nationalisation and for regulation, the political dogma and policy of the party in power and the private interests of groups of consumers and factor owners associated with other modes. Also important were events in other countries and the effect of the war. Yet another important factor must have been the decisions and bargaining skills of the Qantas management. Finally, of course, another factor which affected the development of QEA and the character of regulation of international civil aviation was the method of negotiation with other countries. This is the topic of the next section.

\(^1\) Hansard, HR, 21 October 1947, p.1005.
2.3 INTERNATIONAL AIR TRAFFIC AGREEMENTS

2.3.1 National Sovereignty

The principle of complete and exclusive sovereignty of every state over its air space was generally accepted in 1919, following an international convention in Paris that year, and reaffirmed at the Chicago convention of 1944 (Pyman, 1965). Recognition of this principle meant that air transport could only occur with the agreement of states controlling the transit or end-points of the route. Criticisms, made in 1944 of the international regulation that developed in this environment are quoted by Hocking and Hadon-Cave (1951, p.147) and by Pyman (1965, p.142). The criticisms include (a) any country on an international route could hold operators of other countries 'to ransom' even if those operators only wished to fly over or refuel in its territory, (b) the bargaining for transit or access to traffic introduced 'extraneous considerations and led to international suspicion' and (c) there was no means for controlling extensive subsidisation, 'all too often maintained at great cost for reasons mainly of national prestige or as war potential'. The problem then was perceived as being to achieve order in the skies in a world where individual countries had sovereignty over their air space. The meeting at Chicago was held to discuss this problem.

An example of the application of power over landing rights prior to 1944 occurred on the Kangaroo route. QEA used landing grounds and other facilities in Dutch territory in Indonesia. Since the Dutch had the power under the 1919 convention to refuse landing rights it was in a strong bargaining position and in 1937 Australia was forced to allow a Dutch airline to operate from Australia to
Batavia (Jakarta) with connections to Europe, in competition with the QEA and Imperial Service (although the Dutch service carried no Australian air mail). The service ceased in 1942 when the Japanese occupied Indonesia (Hocking and Haddon-Cave, 1951, pp.90-91).

2.3.2 **British Commonwealth Views**

Members of the British Commonwealth favoured a cooperative approach to regulation of international civil aviation. Prior to the war these countries had cooperated in civil aviation ventures. One example is QEA and another is Tasman Empire Airways Ltd. (TEAL). TEAL, operating by 1940, was formed to extend the Empire air route across the Tasman and was granted a monopoly of the route. The background was that each of the British, Australian and New Zealand governments expected to share in control of the service (Hocking and Haddon-Cave, 1951, pp.91-93). The method they chose was to nominate one of their national airlines (public and private) to take up shares in the operating company and then appoint a representative to a regulatory commission to fix fares and capacity and to monitor the performance of TEAL.

Fysh (1968, p.106) argues the tri-party organisation was used because Australia and New Zealand would not agree to a monopoly by Imperial (later BOAC); New Zealand could not 'go it alone' because of lack of funds and expertise and Australia could not 'go it alone' because of lack of funds, government support and trust by New Zealanders. The result was the cooperative venture.

The Australian nominee was QEA. Hocking and Haddon-Cave (1951, p.92) argue that other companies were ruled out either
because of their association with competing shipping interests or their large foreign (non-British Commonwealth) shareholdings.¹

Fysh (1968) also argues that while the creation of TEAL was an appropriate way of starting trans-Tasman services, the co-operative venture involved large transactions costs because of the difficulty of getting governments to agree. Subsequently, he argues, the enterprise was bound to be inefficient. Evidence that TEAL was inefficient is offered by Brogden (1960, p.161) who says TEAL maintained an old type of aircraft 'beyond the limit of passenger appeal' because New Zealand 'could not afford to replace them'. The reason this could happen was that TEAL had a monopoly of the trans-Tasman route. Fysh reports there was criticism of the monopoly; in particular, the fares trans-Tasman were higher than comparable domestic Australian fares (Fysh, 1970, p.166). Fysh also quotes Brogden as 'the last sensible word' on TEAL (Fysh, 1970, p.166): 'That the continued presence of (TEAL) is really uneconomic is undeniable, but if this argument were continued overseas no small nation would have an airline - including Australia' (Brogden, 1960, p.161).

Eventually, by 1961, the New Zealand government took over TEAL and the trans-Tasman monopoly was replaced by parallel services by TEAL (later Air New Zealand) and QEA.

These three Commonwealth countries created another tri-party venture in 1946 called British Commonwealth Pacific Airlines

¹ A frustrated attempted entrant on this route was the aviation pioneer, Charles Kingsford-Smith, who with a partner (Ulm) had first submitted a proposal in 1935 to fly trans-Tasman. Hocking and Haddon-Cave (1951, p.23) say this proposal was shelved because 'more influential circles were manoeuvring for the right' and because Australia was not free to act without consultation with New Zealand and the UK.
(BCPA). The company was owned half by Australia, 30% by New Zealand and 20% by the UK and formed to operate on trans-Pacific routes. Fysh drawing on his experience with TEAL, described BCPA as 'an ideal which would not work' (Fysh, 1970, p.21). Pyman (1965), explaining the source of the ideal, argues that the Commonwealth countries were willing to use joint ventures because of the atmosphere of the time. After the war, there was a view that a world community could be created by international cooperation and collaboration. The approach (to regulation of international civil aviation) was 'coloured by the "internationalism" which was at the time a very logical and understandable motivating concept' (Pyman, 1965, p.144).

In 1953, BCPA was taken over by QEA and services across the Pacific were divided between QEA and TEAL. The reason for the takeover appears to be that the existence of BCPA had constrained the expansion of QEA and BOAC.  

2.3.3 Chicago Convention

The Chicago convention was held in 1944 to discuss methods of regulation of international civil aviation. The views of the British Commonwealth countries, discussed above, led them to propose multilateral regulation by an international authority. Australia and New Zealand went further and proposed that such an authority should not only regulate but also own and operate air transport services.

---

1 According to Hocking and Hadden-Cave (1951, p.164) BCPA carried more passengers on its Pacific routes (Australia and NZ to Vancouver) than QEA did on the Kangaroo route. Hence the takeover meant a large increase in the size of QEA.
On the other hand, the United States government favoured an international authority limited to technical functions and without economic regulatory power.

These different attitudes to the role of a multilateral authority were reflected in the main issue at Chicago which was the regulation of capacity. As illustrated below, this issue has been a recurring theme in international differences of opinion over civil aviation policy.

The meeting distinguished five types of access or traffic movements which were called 'freedoms' of the air and are defined as follows:

First - to fly across territory without landing
Second - to land for non-traffic purposes
Third - to put down passengers, mail and cargo taken on in the carrier's home state
Fourth - to take on passengers, mail and cargo destined for the carrier's home state
Fifth - to take on or put down passengers, mail and cargo destined for or bound from a third country.

To these original five has been added a sixth which is usually defined as the carriage of traffic between two foreign countries with a stop in the carrier's home state, and which can be regarded as a combination of third and fourth freedoms.

Hocking and Haddon-Cave (1951, ch. 8) describe the main debate at Chicago as being concerned with capacity control and the fifth freedom. The UK proposed that freedoms one to four be granted multilaterally but that capacity should be regulated by a multilateral authority. The fifth freedom would only be granted
bilaterally, in the British proposal. Australia supported this proposal, its own having failed. Other countries, including the US, proposed there should be a general grant of all freedoms of the air and no regulation (equivalently called predetermination) of capacity. Pyman argues that this freedom of the air proposal was 'designed to benefit not only all powerful carrier nations but also those countries which had a strong civil aviation industry, were small in population or had little traffic to offer from their territory' (Pyman, 1965, p.145). Airlines of such countries would gain from access to fifth freedom traffic and from the lack of restriction on capacity.

In 1944, the differing views were irreconcilable so a multilateral exchange of all five rights was not possible nor has it been achieved since then. A multilateral agreement on exchange of the first two freedoms was reached at Chicago and is called the International Air Services Transit Agreement. Other freedoms, and all rights for states not party to the Transit agreement, generally must be exchanged by bilateral agreements, called Air Services Agreements (ASA).1

2.3.4 Air Services Agreements

Australia began to negotiate ASA's in 1946 and in June 1979 had ASA's (or arrangements) with 28 countries.2 The main clauses of interest here relate to capacity, fares and the route to be flown.

---

1 Air services have been offered without formal agreement, for example from Australia to Indonesia (1951-1969), Thailand (1954-1960) and the Philippines (1947-1971), although informal approval was still required. ASA's are here defined to include the Confidential Memoranda of Understanding (CMU).

(i) **Capacity:** There are two approaches to setting total capacity in an ASA. The first, called predetermination, is for the parties to agree on the precise capacity (aircraft size multiplied by frequency in a time period) to be offered by the airlines concerned. Another is for capacity to be controlled on the basis of an *ex post facto* review (see Pyman (1965) and Singh (1981) for detailed discussions). These methods reflect the different views on capacity control of the Chicago conference. Australia has used both methods of capacity control but according to a government report (ICAP, 1978, para 1.8.1, p.28) it favours predetermination.

The basic rule for determining capacity appears to be, in the draft agreement reported in ICAP (1978, Annex D3), the volume of third and fourth freedom traffic. For example a carrier of one party (say Australia) would be given rights to carry traffic from the other country (say Singapore) to a third country (say the UK) and be given capacity to permit carriage of traffic on that sector. But, continuing the example, Australia would have no control over total capacity or fares on the Singapore-UK sector. Fifth freedom access has arisen through the trading that occurs in bilateral talks. For example, in return for Australian rights to traffic beyond Singapore, that country's carrier may be given rights beyond Australia. Generally an attempt is made to limit fifth freedom traffic to a "reasonable" level, claimed to be fifteen per cent of third and fourth freedom traffic.¹

In some cases, a source of conflict in discussion of capacity is the definition of third and fourth freedom traffic. Australia has tended to emphasise the volume of true origin-destination-

---

ion (TOD) traffic. For example, a traveller leaving Australia and bound for the UK may stopover in Singapore. The true origin and destination are Australia and the UK respectively. But Singapore could take the view that this journey is a combination of two in which Singapore is both a destination and an origin. In that case, Singapore would have a claim to the traffic, and to capacity, on the Kangaroo route. In other words, a sixth freedom right would be used to justify extra capacity. These differing views have led to disagreement over capacity. The problem only arises on long routes, where stops must be made.

(ii) Fares: The general principle is that fares be controlled by governments but initially proposed by the airlines through the International Air Transport Association (IATA). The reason for using the multilateral IATA mechanism was that it could take account of relationships between complementary and substitute routes. An airline organisation was used because it was argued airlines had more relevant information (ICAP, 1978, para 1.6.2, p.19). Recently Australia has moved away from the use of IATA and the reasons for this change are discussed below. Once fares are approved by government, domestic law and treaty obligations imply they should be observed; examples of attempts at tariff enforcement are also examined below.

(iii) Routes: Typically ASA's will specify the routes to be flown to and from Australia. Route specification has always been a complex matter for Australia which has tended to be a terminating point on long haul routes so transit stops and rights to pick up traffic at intermediate points have had to be negotiated. The need for transit stops has given countries controlling those points some
bargaining power over access to fifth and sixth freedom traffic. (As will be seen below, an Australian view was that this access was a source of the problems of Australian policy prior to the policy review of 1978.)

2.3.5 **Australian Legislation**

Australian legislation on international traffic the Air Navigation Act 1920-1973,¹ is based on the Chicago convention and subsequent ASA's. The Act ratifies the convention and reflects the ASA's when it says only licenced operators can offer scheduled international air transport² into Australia and only carriers of countries with whom Australia has an agreement can be licenced. The licence can be cancelled if the airline does not conform to the conditions of the ASA or to the regulations accompanying the Act. The Act and its accompanying regulations also specify the tariff enforcement procedure.

2.3.6 **Commercial Agreements**

Bilateral air services agreements are usually followed by commercial agreements (CA) between the airlines. These agreements can amend or confirm capacity set out in the ASA. They can be regarded as an alternative means of controlling capacity, or, as a

---

¹ Although civil aviation is not mentioned in the Australian Constitution, the federal government derives power to legislate from a number of other powers mentioned (Pyman, 1965, 1981).

² Scheduled services are those open to the public, operating according to a published timetable and with regular flights. Operators of non-scheduled flights must have the permission of the Secretary of the Department of Transport (Chicago convention States) or the Minister (non-contracting states) (Section 14).
substitute, a revenue sharing arrangement. A CA would have to be preceded by an ASA, which would operate if the CA lapsed. For example, when Australia planned to alter capacity to Singapore in 1979, Qantas\(^1\) announced its plan to terminate the CA. If the CA expired, capacity would be determined by the ASA. In 1978, Qantas was involved in 15 pooling arrangements (ICAP, 1978, Annex D4).

2.4  RECENT CHANGES IN AUSTRALIAN POLICY ON THE KANGAROO ROUTE\(^2\)

2.4.1  Market Pressure

Since the late 'sixties Australian policy has been subject to market pressure, either competition from carriers such as charter operators on substitute routes, competition from discounting among carriers permitted to fly to Australia or pressure from potential entrants offering lower fares, such as Laker. Until 1978, the typical Australian regulatory response was to change the fare structure, which subsequently became more complicated; fares on the Kangaroo route are listed in Table 2.1 and selected conditions are listed in Table 2.2. Application of this policy led Australia to by-pass the IATA multilateral fare setting mechanism. The reason was

---

1 In 1967, the 'Empire' was dropped from the company name of Qantas Empire Airways Ltd. Henceforth the company is referred to as Qantas. Abbreviations for airline names are used throughout. For example:

- BA: British Airways
- MAS: Malaysian Airline System
- SIA: Singapore Airlines
- Laker: Laker Airways
- Thai: Thai Airways International.

2 This section is a summary of more detailed discussion in Findlay (1981a).
<table>
<thead>
<tr>
<th>Year</th>
<th>First Class (One Way)</th>
<th>Full Economy (One Way)</th>
<th>Pacesetter (Round-Trip)</th>
<th>YLE180 (Round-Trip)</th>
<th>YOX (One Way)</th>
<th>YE270 (Round-Trip)</th>
<th>APEX90 (Round-Trip)</th>
<th>APEX45 (Round-Trip)</th>
<th>APOW (One Way)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>975.00</td>
<td>620.00</td>
<td>390.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1971 (Jan)</td>
<td>1025.30</td>
<td>652.40</td>
<td>420.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1972 (April)</td>
<td>1066.30</td>
<td>678.60</td>
<td>437.00</td>
<td>700.00(^2)</td>
<td>750.00(^2)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1974 (Jan)</td>
<td>1130.30</td>
<td>719.40</td>
<td>463.20</td>
<td>742.00</td>
<td>795.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1974 (April)</td>
<td>1168.00</td>
<td>744.80</td>
<td>481.20</td>
<td>772.00</td>
<td>826.80</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1974 (Oct)</td>
<td>1215.00</td>
<td>744.70</td>
<td>-</td>
<td>802.80(^4)</td>
<td>859.80(^4)</td>
<td>481.104</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1975 (April)</td>
<td>1215.00</td>
<td>774.70</td>
<td>-</td>
<td>867.20</td>
<td>928.60</td>
<td>519.60</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1975 (Nov)</td>
<td>1299.90</td>
<td>828.90</td>
<td>-</td>
<td>945.90</td>
<td>1013.00</td>
<td>566.80</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1975 (Dec)</td>
<td>1338.90</td>
<td>853.70</td>
<td>-</td>
<td>974.40</td>
<td>1043.40</td>
<td>584.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1976 (July)</td>
<td>1339.00</td>
<td>854.00</td>
<td>-</td>
<td>1004.00</td>
<td>1075.00</td>
<td>602.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1977 (Feb)</td>
<td>1473.00</td>
<td>940.00</td>
<td>-</td>
<td>1104.00</td>
<td>1183.00</td>
<td>662.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1977 (April)</td>
<td>1473.00</td>
<td>940.00</td>
<td>-</td>
<td>-</td>
<td>695.00</td>
<td>1000.00</td>
<td>850.00</td>
<td>-1300.00</td>
<td>-1150.00</td>
</tr>
<tr>
<td>1979 (Feb)</td>
<td>1473.00</td>
<td>940.00</td>
<td>-</td>
<td>-</td>
<td>695.00</td>
<td>1000.00</td>
<td>850.00</td>
<td>-1300.00</td>
<td>-1150.00</td>
</tr>
<tr>
<td>1979 (June)</td>
<td>1577.00</td>
<td>1005.00</td>
<td>-</td>
<td>-</td>
<td>744.00</td>
<td>1070.00</td>
<td>910.00</td>
<td>-1391.00</td>
<td>-1231.00</td>
</tr>
<tr>
<td>1979 (Sept)</td>
<td>1813.00</td>
<td>1156.00</td>
<td>-</td>
<td>-</td>
<td>856.00</td>
<td>1232.00</td>
<td>1048.00</td>
<td>-1610.00</td>
<td>-1416.00</td>
</tr>
<tr>
<td>1980 (Jan)</td>
<td>1904.00</td>
<td>1214.00</td>
<td>-</td>
<td>-</td>
<td>899.00</td>
<td>1294.00</td>
<td>1102.00</td>
<td>-1680.00</td>
<td>-1488.00</td>
</tr>
<tr>
<td>1980 (April)</td>
<td>2094.00</td>
<td>1336.00</td>
<td>-</td>
<td>-</td>
<td>989.00</td>
<td>1424.00</td>
<td>1214.00</td>
<td>-1848.00</td>
<td>-1638.00</td>
</tr>
<tr>
<td>1980 (May)(^6)</td>
<td>2304.00</td>
<td>1433.00</td>
<td>-</td>
<td>-</td>
<td>1098.00</td>
<td>1360.00</td>
<td>1288.00</td>
<td>-1988.00</td>
<td>-1738.00</td>
</tr>
<tr>
<td>1980 (July)</td>
<td>2373.00</td>
<td>1476.00</td>
<td>-</td>
<td>-</td>
<td>1098.00</td>
<td>1360.00</td>
<td>1328.00</td>
<td>-1988.00</td>
<td>-1792.00</td>
</tr>
<tr>
<td>1980 (Sept)</td>
<td>2421.00</td>
<td>1505.00</td>
<td>-</td>
<td>-</td>
<td>1121.00</td>
<td>1388.00</td>
<td>1382.00</td>
<td>-2030.00</td>
<td>-1864.00</td>
</tr>
<tr>
<td>1981 (July)(^7)</td>
<td>2493.00</td>
<td>1580.00</td>
<td>-</td>
<td>-</td>
<td>1154.00</td>
<td>1430.00</td>
<td>1424.00</td>
<td>-2090.00</td>
<td>-1920.00</td>
</tr>
</tbody>
</table>

\(^2\) Rates for 1972 (April) and 1974 (April) include a 10% discount for bookings made before departure.
\(^4\) Rates for 1974 (Oct) include a 5% discount for bookings made before departure.
\(^5\) Rates for 1977 (Feb) and 1977 (April) include a 7% discount for bookings made before departure.

\(^6\) Rates for 1980 (May) include a 10% discount for bookings made before departure.

\(^7\) Rates for 1981 (July) include a 12% discount for bookings made before departure.
NOTES TO TABLE 2.1

1. In 1967 there was a 5 per cent return fare rebate which was dropped by 1971.
2. The YHE180 fares were available from 1.2.72 but the YOX fare was not available until 1.4.72.
3. The Pacesetter fare was cancelled in December 1974.
4. Restrictions on YOX, YHE180 and YLE180 fares were changed in December 1974.
5. YHE180 and YLE180 fares to the UK were cancelled in April 1977.
6. YE270 replaced by YE21/1 yr. and APEX45 replaced by APEX30.
7. Group travel fares are also available.
### TABLE 2.2: Kangaroo Route Selected Fare Conditions (14 December 1980)

<table>
<thead>
<tr>
<th>Fare</th>
<th>Maximum Stay</th>
<th>Minimum Stay</th>
<th>Advance Purchase Period</th>
<th>Cancellation Penalty</th>
<th>Stopovers</th>
</tr>
</thead>
<tbody>
<tr>
<td>YOX</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>YE21/1 yr</td>
<td>21 days</td>
<td>365 days</td>
<td>None</td>
<td>None</td>
<td>1 @ $A153</td>
</tr>
<tr>
<td>APEX90</td>
<td>21 days</td>
<td>270 days</td>
<td>90 days</td>
<td>after 90 days, 25%</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>after travel, 100%</td>
<td></td>
</tr>
<tr>
<td>APEX30*</td>
<td>None</td>
<td>365 days</td>
<td>30 days</td>
<td>before 30 days, $A50</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>after 30 days, 50%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>after travel, 50%</td>
<td></td>
</tr>
<tr>
<td>APOW*</td>
<td>None</td>
<td>None</td>
<td>30 days</td>
<td>as for APEX30</td>
<td>None</td>
</tr>
</tbody>
</table>

* Available on services of a limited number of carriers.
IATA, at that time,\(^1\) required unanimity on new fare proposals which meant they could be vetoed by other countries, for example, those along the route which would have lost from restrictions on stopovers.

In 1978, following another attempt by Laker to enter the Kangaroo route, the regulatory response was to review the whole policy. The context of this decision was that the Laker entry bid contradicted an earlier claim by officers of the Department of Transport that fares then available included the lowest possible. The Minister could have accepted the Laker bid, satisfying consumer expectations of lower fares that it probably created, but was concerned with its effects on service quality.\(^2\) The international civil aviation policy (ICAP) review committee was established to resolve the uncertainties. The committee’s report (ICAP, 1978) led to a new policy and subsequently a dispute with countries along the route, like the members of ASEAN.

### 2.4.2 ICAP\(^3\)

The Australian view of the existing regime, evident in the ICAP report was that it had not been successful in achieving efficient utilisation of capacity. Nor had it been successful in achieving an optimal fare structure, which meant cost-based fares and lower fares to at least some passengers. There were the two problems which the review of Australian policy was hoped to solve.

---

3. The policy introduced following the report of the review committee is commonly called ICAP.
A number of options were considered. The policy chosen was called a third and fourth freedom regime, which meant an attempt was to be made to restrict traffic on all routes to end-point-country carriers. There are a couple of ways of interpreting this policy. One is that Australia was simply trying to enforce its view that TOD traffic was the correct rule to fix capacity. The policy can also be described as an attempt to export 'the Two Airline Policy' (the name given to domestic policy) that is, to monopolise the traffic on each route by a cartel of end-point-country carriers. This was recognised by the authors of the ICAP report who wrote (para. 5.4.5, p.142) the policy 'may be perceived, albeit unreasonably, as a "Two Airline Policy" on Australia's international routes'. Their concern was that the absence of competition would mean little pressure on the airlines to increase efficiency which would expand the government's regulatory burden. (The extent of this effect of regulation is a major topic of this thesis.)

The policy offered the opportunity to solve the problems identified by Australia. Control of capacity would raise loads, lower unit costs and permit lower fares to some passengers. These lower fares would increase demand, further raising loads. Some increase might be required, however, in higher fares so that the airlines could continue to break even, given the addition of new lower fares at the bottom of the fare structure. But success of the policy hinged on being able to control capacity, otherwise sixth freedom traffic would not be crowded out. The policy was consistent with the constraints imposed on the policy review. These were that scheduled service should be maintained, that an Australian carrier
should be protected and that the policy should be implemented by the mechanism of bilateral agreements.¹

The new policy was first applied in February 1979 to the Kangaroo route, after negotiation with the British. This route was commercially important to Qantas and excess capacity was regarded as a problem on the route.

The basic mechanisms of the new policy were the attempts to more effectively control capacity, combined with a new fare structure. Other countries objected to both aspects of the policy. For example, the ASEAN countries, who, upon Singapore's urging, negotiated as a group with Australia, caused Australia to relent on some of its original proposals.² In particular, these countries objected to the third and fourth freedom regime. This dispute, over rules for fixing capacity, was the same as the dispute at Chicago in 1944 (see Section 2.3.3). Other countries objected to the proposed

¹ The phrase 'consistent with the continued commercially viable operation of an Australian flag carrier or carriers' is included in the terms of reference given to the committee (ICAP, 1978, p. iv). The terms of reference also ask the committee to consider the impact of policy options on service quality and to report on the institutional constraints to changing the policy.

² Apart from the two mechanisms mentioned, supplementary tools were to restrict some ticket types to third and fourth freedom carriers and to discourage stopovers (the new and relatively much cheaper advance purchase fares (see Table 2.1) did not offer stopovers). The ASEAN countries objected to these proposals and Australia agreed in talks in 1979 to allow stopovers on new APEX fares at a surcharge and to give ASEAN carriers access to those fares. However, these parts of the deal, unlike the capacity and fares components, were never formally implemented because of lack of British approval. Australia had originally proposed to cut SIA capacity to Australia but the result of the talks was no change to SIA capacity while all other ASEAN carriers flew an extra DC10 equivalent per week.
changes in the fare structure, in particular, raising fares to some travellers.

Forsyth (1981b, pp.2-3) notes a change in the character of Australian regulation at this time. Previously, the regulators were responding mainly to pressure from entrants based in the end-point countries, such as Laker. Now they were trying to restrict capacity and protect Qantas against carriers from third countries. In that sense, Forsyth argues, regulation of international civil aviation now had characteristics of other types of protection in international trade.

2.4.3 Assessment of ICAP

Australian goals of higher loads and lower fares for some passengers were both achieved by ICAP. The lower fares available in 1979 are evident (on the Kangaroo route) in Table 2.1. The effect of the new policy on loads on Qantas and BA flights in 1979, compared to 1978, is evident in Table 2.3 (which includes data on ASEAN carriers' loads). But neither sufficient control of capacity nor the ideal fare structure appear to have been achieved.

Evidence of this failure is that discounting continued after ICAP. Since capacity was not tightly controlled, sixth freedom traffic had not been crowded out; carriers of this traffic could attract passengers by discounting. The opportunity for discounting was increased by the large gap between the new APEX fares and the excursion fare which offered a "legal" stopover.

---

1 See Forsyth (1981a, p.6) and Singh (1981, p.57).

2 One method of discounting was to offer APEX tickets to the UK, on ASEAN airlines, at the same price as Qantas and BA but without enforcing the conditions (see National Times, 28 December 1980, p.4).
### TABLE 2.3: Load Factors on Australian Routes

<table>
<thead>
<tr>
<th>CARRIER</th>
<th>ROUTE</th>
<th>1978</th>
<th>1979</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA 1</td>
<td>UK</td>
<td>0.36</td>
<td>0.63</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.40</td>
<td>0.61</td>
<td>0.55</td>
</tr>
<tr>
<td>QANTAS2</td>
<td>UK via SIN, KUL</td>
<td>0.61</td>
<td>0.69</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.55</td>
<td>0.66</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>UK via BOM</td>
<td>0.73</td>
<td>0.86</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.74</td>
<td>0.81</td>
<td>0.78</td>
</tr>
<tr>
<td>GARUDA4</td>
<td>Indonesia</td>
<td>0.37</td>
<td>0.55</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.42</td>
<td>0.59</td>
<td>0.64</td>
</tr>
<tr>
<td>MAS5</td>
<td>Malaysia</td>
<td>0.47</td>
<td>0.54</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.32</td>
<td>0.41</td>
<td>0.57</td>
</tr>
<tr>
<td>PAL6</td>
<td>Philippines</td>
<td>0.58</td>
<td>0.65</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.54</td>
<td>0.56</td>
<td>0.73</td>
</tr>
<tr>
<td>SIA7</td>
<td>Singapore</td>
<td>0.66</td>
<td>0.73</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.68</td>
<td>0.76</td>
<td>0.78</td>
</tr>
<tr>
<td>THAI8</td>
<td>Thailand</td>
<td>0.54</td>
<td>0.54</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>0.52</td>
<td>0.49</td>
<td>0.72</td>
</tr>
</tbody>
</table>

**Notes:**

1. Passenger flight capacity only: B747 flights or 404 seats
2. B747; 410 seats
3. Includes UK via Athens from September, 1980
4. DC10; 270 seats
5. B707, ABUS, DC10; 206 seats in 1978 and 1979; 263 seats in 1980
6. DC8, DC10; 224 seats in 1978 and 1979; 258 seats in 1980
7. B707, B747; 254, 257 and 349 seats respectively
8. DC10; 262 seats.

**Source:** DOT, Air Transport Statistics, International Air Transport DOT, Approved Timetables.
Meanwhile, in part due to lack of support from governments owning foreign carriers, attempts to control discounting in Australia appear to have been ineffective.

Regulations on fare enforcement were last reviewed in 1976 following claims of significant discounting, called 'malpractice' by some in the industry. The effect of the revisions was to raise the expected cost of discounting by raising the penalty and likelihood of detection. The penalty for offering or changing fares less than the approved tariff was a fine of up to $1,000 or imprisonment up to two years or both. However, no prosecutions were made using this power until 1981. Only two travel agents were fined. A reason for this lag was, until recently, lack of evidence which would sustain a case in court. Further prosecutions seem unlikely after the policy change discussed below. The failure of the fare enforcement policy is not surprising; it would have been more surprising if the government had been able to find political support from consumers for prosecutions against people offering them a better deal!

In summary, Australia appears to have achieved neither the degree of capacity control it wanted nor its ideal fare structure. Both problems have contributed to Qantas' recent reported (accounting) losses. The reason is that Qantas revenue yields may

1 Air Navigation Regulation 106A, as amended on 12 February 1976. Previously the maximum penalty was $400.

2 Qantas' operating profit (loss) on airline operations and after extraordinary items was

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit - on airline operations ($m)</td>
<td>16.0</td>
<td>22.7</td>
<td>(10.2)</td>
<td>(41.0)</td>
</tr>
<tr>
<td>Profit - after extraordinary items and income tax ($m)</td>
<td>6.5</td>
<td>0.8</td>
<td>(21.2)</td>
<td>(19.6)</td>
</tr>
</tbody>
</table>

[cont.]
have been reduced by the addition of new lower fares to the structure, combined with loss of higher yielding traffic to discounting.

2.4.4 Recent Policy Change

The Australian regulators have been concerned about Qantas' financial problems. One reported\(^1\) response to the problem of loss of traffic to discounting in Australia has been a new package negotiated with the British and put to the ASEAN countries. Some parts of this package are specific to the Kangaroo route (ASEAN access to all ticket types and new excursion fares) but the policy also indicates a new general approach to regulation of fares.

The main features of the new approach are

(a) fares can be set by third and fourth freedom carriers (but can be matched by other carriers)

(b) immediate approval to sell new fares (carriage of traffic at those fares is conditional on Ministerial approval)

(c) the Departmental role is now to advise the Minister on consequences of accepting the fares proposed but it does not analyse the proposal in detail (previously the Secretary of the Department made the

---

2 More accurate data on profitability are presented below. Of course, the policy variables are not the only factors likely to have affected reported performance. Others (including rising fuel prices, decreasing demand and changing exchange rates) are discussed by the Qantas chief executive in the Australian Financial Review, Aviation 81: Special Survey, 3 August 1981, pp.2-3. His expectation that 1981 would be a 'worse' year than 1980 was fulfilled.

approval decisions and airlines could not ask for increases without justification, as they now can do).

The implication of this approach is that discounting will be facilitated. Firms, including Qantas, will be able to respond to strategies of competitors more quickly. Different fares can be charged for the same journey. Effectively, the approach means the end of attempts to control fares. However, the new policy currently applies on only four routes (UK, US, Hong Kong and New Zealand) although it is planned to extend the policy.

To summarise recent events, the policy following the ICAP Report appears to be an attempt, within the existing regime of control of fares, capacity and entry, to more effectively control capacity (in order to raise loads while continuing to protect the flag carrier) and at the same time redistribute the costs of capacity among consumer groups, to meet the expectations probably created by pressure from market entrants. The crucial part of this policy was to limit capacity to the size of third and fourth freedom markets on each route. This has proved to be difficult and subsequently Australia appears to be moving to a new policy. The

1 A qualification to this conclusion is that according to the regulations accompanying the Air Navigation Act, the Department could control only minimum fares. In other words, it could prosecute a person selling tickets for less than the price agreed by the Secretary of the Department. Strictly it had no power to enforce the fares as a maximum; it had to rely on persuasion, to avoid filings of fares it thought were too high, and on competition between the carriers, to prevent abuse of monopoly power.

2 On other routes, the Department of Transport Australia appears to be not enforcing the approved fares. Substantial discounts (up to $400) on approved fares have been reported to have been available although recently airlines on Australia-Europe routes agreed to a 'yield improvement program' to limit these discounts to $150 (Australian Financial Review, 18 January 1982, p.10).
new policy is to continue to try to control capacity but, at the same time, abandon attempts to control fares, implying a different distribution of the costs of capacity, but still consistent with protection of the flag carrier. This description of events suggests a number of *ex post* rationalisations of the policy changes, in terms of the private interest model of regulation, and speculations along these lines are discussed in later chapters. In Chapter 10 there is detailed analysis of the implications of the relaxation of control of fares.

2.5 SUMMARY

Australian regulation of international civil aviation can be characterised as control of entry, capacity and fares. The mechanisms of regulation include a series of bilateral agreements enforced by domestic legislation. However, the regulatory policy has always been subject to market pressures. The most recent response to that pressure has been, in Australia, to move toward less control of fares while maintaining control of entry and capacity.

From the start, the Australian government has intervened in civil aviation markets. It not only regulates capacity and entry but also owns the flag carrier, Qantas. A number of motives have been mentioned for intervention and for its characteristics. One case made for intervention has been that this sector generates positive externalities, in particular, related to defence. A case for regulation of entry, capacity and fares has been based on the context of international negotiation of traffic rights and national sovereignty over airspace. Finally, cases for government ownership
have emphasised problems of monitoring the performance of firms in privileged positions, as well as arguments about failures in the capital market. These motives, and others used more recently, are examined below. As a preliminary to that discussion, it is valuable to develop a model of an air transport system that can be used to discuss the case for, and effects of, intervention. This model is presented in the next chapter.
CHAPTER 3: MODEL OF AN AIR TRANSPORT SYSTEM

3.1 INTRODUCTION

This chapter presents a model of an air transport system which has a number of applications in this, and subsequent chapters. It is used here to compare optimality and the outcome of competition and the results of this comparison are used in Chapter 4 to comment on a market failure argument made by the authors of the ICAP Report (see Section 2.4). A special case of the model can be illustrated diagrammatically and this version of the model is used in Chapter 9, to measure the welfare cost of regulation, and in Chapter 10, to discuss policy options. Another version of the model is used in Chapter 5 to examine rent seeking motives for intervention.

Air transport is regarded here as a jointly consumed but congestible service. The extent of congestion depends on the size of the facility, in other words, capacity, and the number of passenger trips. These elements of congestion can be summarised in a congestion, or delay, function; the specification of this delay function is described in detail below. The extent of delay can be regarded as an index of service quality and consumer welfare will depend on this index as well as the money fare. This view of air transport readily applies to scheduled services. Once-only charter flights could be thought of as a joint good where the joint products are trips in two directions as well as joint use of the flight capacity.

A similar view of transport services has been taken elsewhere in the literature and the problem of determining optimal
pricing and investment\(^1\) in these conditions has received considerable attention. For example, road construction has been examined by Strotz (1965), Vickrey (1969), Dafermos and Sparrow (1971) and Keeler and Small (1977). Optimal bus fares and frequencies have been derived by Mohring (1972). Optimal taxi fares and service quality have been discussed by Douglas (1972) and optimality rules for air transport have been derived by de Neufville and Mira (1974), Forsyth and Hocking (1978b) and Panzar (1979b). Douglas and Miller (1974) also discuss optimal service quality. But as Forsyth and Hocking (1978b) point out, Douglas and Miller used the appropriate optimal frequency condition at the current output but imposed a break even pricing rule, which need not be optimal. A common result is that passengers should be charged a fare equal to the marginal social cost of travel and that optimal total output of the service could require non-zero profits. Some of the aims of the work reported here are to review the derivation of the optimality rules for air transport and the source of the non-zero profit condition.

Different methods have been used to derive air transport optimality conditions. For example, Forsyth and Hocking (1978b) and de Neufville and Mira (1974) use a consumer surplus type of maximand where consumer benefits are assumed to depend on trips and flight frequency. Panzar (1979b) uses a similar maximand in which surplus is defined as the area below the demand curve above the full price of travel, which includes delay. A different approach is that of Strotz (1965) who defines consumer utility as a function of trips,

\(^1\) There is also a large literature on optimal pricing of a given facility, e.g., Walters (1961).
all other goods and trip quality, indexed by delay, and then derives a Pareto optimal solution by maximising one person's utility subject to constraints on utilities of other people and resources. This method, called here the Strotz parable, has also been used by Oakland (1972) and Kay (1979). Its value is that it offers more information on the source of the non-zero profit condition because it makes explicit the form of the delay (or inconvenience) function. This type of model has also been synthesised with models of optimal club size and utilisation (Sandler and Tschirhart, 1980, 1981) and further reference to the clubs literature is made below.

The plan of the rest of this chapter is the following. Section 3.2 presents the Strotz parable and Section 3.3 derives the optimality conditions for a special case of the utility function. Section 3.4 contains a comparison of market results and optimality for the special case. The results are illustrated in Section 3.5.

3.2 STROTZ' PARABLE

Assume there are I persons in the community and the utility function of person $i(U^i)$ is

$$U^i = U^i(t^i, d, x^i) \quad i = 1...I$$

(1)

where

$$t^i = \text{number of trips on the route of interest in the time period considered by person } i$$

---

1 A copy of Dorman's (1976) thesis was obtained after the first draft of this chapter was completed. Dorman also uses the Strotz model to derive the optimality conditions. However, Dorman's interpretation of the results has a different emphasis, some implications of which are noted below. Dorman also uses a different model of competition and uses a technique different from that in Section 3.4 to compare optimality and market results. These differences are noted below.
\[ x^i = \text{consumption of all other commodities by person } i \]
\[ d = \text{average delay} \]

and

\[ U^i_t > 0, U^i_d < 0, U^i_x > 0. \]  
\[ U^i_{tt} < 0, U^i_{dd} < 0, U^i_{xx} < 0. \] \hspace{1cm} (2)

Delay is the result of provision of trip making facilities in lumpy units. There are two types of delay, called frequency and stochastic delay (Douglas and Miller, 1974). The first type occurs because passengers on average face a gap between their ideal and available departure times. This gap is called frequency delay and its average over all travellers in the system increases as flight frequency decreases. The second type of delay occurs because demand for travel at a particular time is stochastic. On some days, a flight at a particular time will be fully booked so passengers excluded will have to wait until the next flight. The cost of this delay depends on the gap between flights and the probability of having to wait, which will increase with the average load factor. Congestion of aircraft and complementary facilities can also increase waiting times for ticket checks or baggage and otherwise reduce the comfort of travel and airspace near terminals will become more congested as flight frequency increases. These effects could be included in the delay function\(^1\).

The total number of passenger trips \(T\) and total output of other commodities \(X\) are, respectively

---

1 The case of frequency delay only is considered in detail by Forsyth and Hocking (1978b) (as well as the case of both types of delay), by de Neufville and Mira (1974) and Panzar (1979a) and, in taxi-cab case, by Douglas (1972). De Neufville and Mira (1974) also consider the case where increasing frequency adds to delays through congestion of air space.
\[ T = \sum_{i} t_i \quad (3) \]

\[ X = \sum_{i} x_i \quad (4) \]

The cost of providing \( F \) flights is \( C(F) \) so if \( R \) is the aggregate resource per period available to the community then a constraint is

\[ X = X(R - C(F)) \quad X' > 0, \ X'' < 0. \quad (5) \]

It is assumed that flights are provided as lumpy units of capacity at a constant marginal, equal to average, cost \( k \).

The next step is to specify the determinants of average delay \( d \). Here it is assumed that

\[ d = D(T,F) \quad (6) \]

where \( D_T > 0, \ D_F < 0, \ D_{TT} > 0, \ D_{FF} > 0 \) and \( D_{TF} \leq 0 \).

\( F \) is included because of the presence of frequency delay and the inclusion of \( T \) implies there is stochastic delay as well. If units of capacity were perfectly divisible there would be no frequency delay (the Superman case) nor would there by any stochastic delay, although there could still be congestion of complementary facilities.

It might be argued that a relevant constraint is that of seating capacity on each flight. This is assumed not to be binding on average. The reason is that with full aircraft, stochastic delay costs will become very high. In other words, full loads on all flights cannot be efficient since they imply such high waiting costs.

The problem is to find a price ratio and a flight frequency that, in these conditions, will yield a Pareto optimum. The method of deriving the necessary conditions for an optimum is to fix utility levels of all but one person and maximise that person's utility subject to constraints on utilities of other people, resources and the nature of the delay function.
Let $c^j$ be the fixed utility level of person $j$ and form the Lagrangean ($L$)

$$L = \sum_i w^i [U^i(t^i, d, x^i) - c^i] + a(d - D(T,F)) + b(X - X(R - kF)) \quad (7)$$

Assume $w^i = 1$ and $c^i = 0$ then the other $w^i$ can be thought of as Lagrangean multipliers.

The necessary conditions (which are taken to be sufficient) for a Pareto optimum are the following

1. $w^i U^i_t - a D_T = 0 \quad i = 1 \ldots I \quad (8)$
2. $\sum_i w^i U^i_d = 0 \quad (9)$
3. $w^i U^i_x + b = 0 \quad i = 1 \ldots I \quad (10)$
4. $bX'k - aD_F = 0 \quad (11)$
5. $d - D(T,F) = 0 \quad (12)$
6. $X - X(R - kF) = 0 \quad (13)$
7. $U^i(t^i, d, x^i) - c^i = 0 \quad i = 1 \ldots I-1 \quad (14)$

There are $3I + 3$ equations, equal to the number of unknowns $(t^i, x^i, a, b, d, F, w^i)$ in this problem where the number of individuals who travel is fixed.$^1$

This set of conditions can be rearranged to indicate the characteristics of the optimum. First note that $w^i U^i_x$ is equal for all $i$. Then from (8), (9), (10) and (11)

$$\frac{U^i_t}{U^i_x} = - \frac{\sum_i w^i}{\sum_i w^i x} D_T \quad (15)$$

---

$^1$ In the clubs literature, the optimisation would have included $1$ as well; that is, club membership would have been a variable. Here it is assumed that the population is the membership. This assumption is reviewed in Chapter 4.
Equations (15) and (16) are similar to the optimality conditions for joint goods. The joint goods, which enter all travellers' utility functions in equal amounts, are flight frequency (F) and the utilisation of existing flight facilities (T). Equation (15) says that $t^i$ should be increased, raising $T$, until the marginal benefit to the traveller equals the marginal costs imposed on other travellers. Equation (16) says that frequency should be increased until its marginal cost equals the sum of the marginal evaluations of reductions in delay.\(^1\)

Combining (15) and (16) leads to (17)

$$X'k = \sum_i \frac{u_i^d}{u_i^x} D_F$$

1 In the Strotz model, the facility is shared by people of differing tastes. In the clubs literature this would be called a 'mixed club'. It is plausible that forcing people of differing tastes to share the same facility could be sub-optimal and, recently, Berglas and Pines (1981) claim to have shown that mixed transport clubs are not optimal. In a comment on this result, however, Sandler and Tschirhart show that it follows from a self-financing constraint imposed by Berglas and Pines. The self financing constraint would be appropriate when 'the club' is characterised by constant costs of capacity and a delay function homogeneous of degree zero in trips and flight frequency (see below), that is, by constant returns to scale. The intuitive explanation of the non-optimality of mixed clubs is then clear; under constant returns to scale it is possible to have a separate 'club' to cater precisely for each person's tastes. Although the assumption of constant returns is adopted below (see Chapter 3), it is not assumed that this assumption is relevant over the whole range of possible output. Sandler and Tschirhart (1981) also show that in the type of problem considered here, mixing is optimal. Taste differences for service quality are accounted for by differing utilisation rates and total toll payments. In terms of the first order conditions, the mixed club is optimal because the evaluation of a unit of congestion is reflected in both the toll condition and the capacity condition.
The right hand side of (17) is the same for all travellers so each individual's marginal rate of substitution between trips and other goods will be equal. Hence a situation where each person faces the same set of relative prices can lead to an optimal result. The next step is to determine the optimum relative prices. The approach is to consider the problem facing each person. Let

\[
\begin{align*}
 P &= \text{fare} \\
 V &= \text{price of other goods} \\
 R^i &= \text{income from sales of resources (whose price is unity)} \\
 O^i &= \text{profits earned} \\
 H^i &= \text{lump sum tax paid}
\end{align*}
\]

Then the individual's constraint is

\[
R^i + O^i - H^i = Pt^i + Vx^i
\]

(18)

The individual's problem is to maximise

\[
U^i = U^i(t^i, d, x^i)
\]

subject to (18), using \( t^i \) and \( x^i \); \( d \) is regarded as fixed by an individual. At the individual's optimum

\[
\frac{U^i_t}{U^i_x} = \frac{P}{V}
\]

Combining (19) and (17), the optimal price ratio is

\[
\frac{P}{V} = -x'k \frac{D_T}{D_F}
\]

(20)

The next step is to determine the optimal number of flights. The average delay function was defined in (6); now let

\[
a = D^iT + D_F
\]

(21)

1 a is not equal to the degree of homogeneity of delay function, since \( a = d \cdot h \) where \( h \) is the degree of homogeneity.
If $D$ was homogeneous of degree zero then $a = 0$ but generally it is expected that $a$ is non-positive. The reason is the following (Mohring, 1972).

Ignoring airspace congestion, consider the time a traveller spends waiting for a flight. Assume expected waiting time is equal to half the time between flight departures which are evenly spaced over the day. Then suppose $T$ and $F$ double. Times between departures would then be halved so average delay would fall. As a result, $a < 0$; Strotz calls this a case of "favourable" returns to scale (Strotz, 1965, p.135).

Expenditure on flights is assumed to equal sales revenue plus tax revenue ($H^i$ by person $i$).

$$kF = \sum_{i} H^i + P \tau^i$$  

(22)

The question is the appropriate total tax revenue. Assume the other goods sector is competitive so, assuming resources to be the numeraire,

$$X'V = 1 \text{ or } X' = 1/V \text{ and from (20)}$$

$$P = -\frac{kD_T}{D_F}$$  

(23)

To interpret this expression for price, fix delay then

$$\frac{dT}{dF} \bigg|_{D=D_T} = - \frac{D_F}{D_T}$$

so

$$P = k/ \left| \frac{dT}{dF} \right|_{D=D_T}$$  

(24)

which is the marginal cost of an extra trip holding service quality constant. Then from (21)

$$kF = \frac{ka}{D_F} - kT(D_T/D_F)$$

$$= \frac{ka}{D_F} + PT$$  

(25)
In (25), if $a < 0$ and since $D_F < 0$ flight expenditures will exceed sales receipts at the optimum, even though cost per flight $(k)$ is constant.

The results can be interpreted by considering some special cases. Say delay depended only on $F$ and not on $T$. Then $F$ could be thought of as a public good and the optimality condition would be (16). Revenue equal to the cost of the marginal flight could be raised by taxing each consumer an amount equal to his marginal evaluation of an extra flight. The trip fare should be equal to the marginal cost of a passenger which in this case is zero. The outcome can be thought of as a travel club, members of which pay a varying joining fee but travel on the route at no extra cost.

The other special case is where flights do not enter the delay function but where delays increase with $T$. This is a case of a consumption external diseconomy, (15) applies and a congestion tax should be levied on travellers. This case could be thought of as a community of super people, the more of whom fly, the more congested flight paths become.

The model presented above is a combination of these two cases (as noted by Forsyth and Hocking (1978b, p.13)). While revenue is raised from a congestion tax, it need not be sufficient to cover the costs of the optimum number of flights.

3.3 SPECIAL CASE OF UTILITY FUNCTION

Equation (1) defined a general utility function and a special case (suggested by Kay (1979)) can be derived by assuming $D(T,F)$ is a unit cost function which has the same value for everybody. The utility function can then be written

$$U^i = U^i(t^i, x^i - t^iD(T,F))$$  (1b)
Individuals in this specification are not identical, because their preferences for trips can vary, but when a trip is made, they each face the same average delay cost, in terms of good x. In that case, the individual's and, subsequently, the market demand for trips can be written as a function of the "full fare" \(((P/V) + D)\). Substituting from (1b) into (15) and (16), the optimal toll \((P/V)\) in this case is \(TD_f\) which is the marginal social cost of the extra trip and when frequency is optimal

\[ x'k = -TD_f \]  

so the marginal cost of an extra flight must equal the marginal gain. Total revenue will be

\[ T(P/V) = T^2D_T \]

and total cost will be

\[ Fk/V = -TFD_F \]

Hence, the subsidy required will be, in units of the private good,

\[-T(FD_F + TD_T) = -Ta\]

or, since \(T = -kx'/D_F\), the subsidy equals \(ka/D_F\) (in units of the numeraire) which was the result from Section 3.2. If \(a = 0\), no subsidy is required.

In a model which emphasised the location of flights in time (analogous to the location of ice-cream sellers around a lake) Panzar (1979b)\(^1\) derived the conditions for zero profits at the optimum. The Panzar conditions were that the value of frequency

---

\(^1\) Telser's (1969, 1971) frequency-delay-only model is a special case of Panzar's (1979b) model. The case of frequency delay only corresponds to the characteristics of spatial markets, a point evident in Telser's (1969) model of this problem. But in a comment on Telser (1969), Demsetz (1971) pointed out that
delay is zero and the direct\(^1\) marginal effect of a change in frequency on stochastic delay (through a reduction in the gap between flights) is zero. There is still delay due to congestion in these conditions but the optimal toll is such that tax revenue covers the cost of providing flights. This corresponds to the case where delay depends only on the load factor of each flight, which implies the delay function is homogeneous of degree zero (\(a = 0\)). Hence the Panzar condition and that derived here, for zero profits at the optimum, are equivalent.\(^2\)

3.4 MARKET RESULTS

The next step is to compare the optimal results and those generated by types of markets. Assume initially there is just one

---

1 Telser had ignored differential land rent, arising because of (cont) differing distances of consumers from the point of purchase (a factory in the Telser model). Subsequently, Southey (1974) showed that when the owner of the factory could capture these differential rents, the frequency of factories would be optimal. The application of these results to air transport is limited. It is difficult to imagine how airlines would capture the surpluses of consumers located close to flight departure time. Southey's optimality result only applies in the case limited to frequency delay so when frequency also has a direct effect on stochastic delay, frequency will still be too low.

The delay function \(D(T,F)\) can also be written \(E(T/F,F)\) then \(E_T = E_{1/F}\) and \(E_F = E_2 - TE_{1/F}\) so \(a = TE_T + FE_F = FE_2\) where \(E_2\) is the direct effect of frequency on delay (the indirect effect is via the load factor) so \(a = 0\) when \(E_2 = 0\). In that case delay depends only on \(T/F\).

2 At this point it is appropriate to summarise some differences between Dorman's (1976) analysis and that used here. Dorman does not emphasise the separate optimal toll and frequency conditions, does not offer the congestion toll interpretation of the optimal toll condition and does not consider the self financing characteristics of optimality. Dorman does derive the same general optimality rule (equation (20) above) but discusses marginal cost pricing using an equation like (24).
firm providing all flights and take capacity as fixed; these assumptions will later be relaxed. The firm is a profit maximiser and its problem is to choose a price \((P)\). The pricing rule is to set marginal revenue to zero, as shown in (27).

\[ \frac{dT_P}{dP} = T + P\frac{dT}{dP} = 0 \]  

(27)

An expression for \(P\) can be obtained from (27) by noting (Kay, 1979)

\[ \frac{dT}{dP} = \left(\frac{\partial T}{\partial P}\right)_D + \left(\frac{\partial T}{\partial D}\right)_P D \frac{dT}{dP} \]

then multiplying both sides by \(P/T\) and using (27) it can be shown that

\[ P = \frac{-TD_T \left(\frac{\partial P}{\partial D}\right)_T}{1 - (1/e)} \]

where \(e = -\left(\frac{\partial T}{\partial P}\right)_D P > 0\)

and \(\left(\frac{\partial P}{\partial D}\right)_T = -\left(\frac{\partial T}{\partial D}\right)_P \left(\frac{\partial T}{\partial P}\right)_D\).

In the special case, the individual's demand can be written

\[ t^i = t^i(P + D) \]

and then for all \(i\)

\[ \left(\frac{\partial P}{\partial D}\right)_T = -1 \]

Therefore

\[ P = TD_T/(1-(1/e)) \]  

(28)

and this price exceeds \(TD_T\).

The pricing rule (28) shows that the relationship between the price and the optimal toll \((TD_T)\) depends on \(e\), which is the

---

1 This price is actually relative to the price of the private good, but in this section and that following, the private good is taken as the numeraire. This means 'k' is redefined as the cost of the extra flight in terms of the new numeraire.
price elasticity of demand for units of constant quality. The higher is \( e \), the closer the price will be to the optimal toll.

The elasticity \( (e) \) will vary with the structure of the market. In competition, where there is free entry, \( e \) will be very high. For example, say the firm tried to raise price without changing the level of delay. All passengers would be worse off and would immediately switch to an entrant offering the old mix of price and quality.

In this model, the individual has the same reaction to a rise in the money price given \( d \), or a rise in \( d \) given \( P \). Thus a high value of \( (e) \), the response to a change in the money price, also implies a high response to a change in \( d \) given the money price. These results imply that in competition the firm faces a very elastic full price \( (P+d) \) demand curve at the going full price. In other words, the competitive firm must take the full price as given for the optimal money toll to be generated.

The model of competition discussed so far referred to the behaviour of a single firm supplying all flights but decentralised decision makers can also reach the optimal toll and utilisation. Let each flight correspond to one firm. Each firm takes the full price of travel as given. No firm has any locational advantage over another so total traffic, which is fixed since the full price is fixed, will be divided equally between all firms. Each firm acts believing it can choose its own combination of money fare and passengers, with the aim of maximising revenue, as long as it takes the full price as given. It can be shown that the money fare will
then equal the optimal toll,\(^1\) when the target load factor is achieved. If there are excess seats then the full price will fall and competitive firms will readjust their money fares.

There are other models of competition in the literature. Some (e.g., De Vany (1975) and Douglas and Miller (1974, ch. 4)) refer to a regulated environment where the money fare is fixed. Panzar (1979b) develops a model where firms take their rivals' money fare as fixed (and shows that the competitive result will not be optimal). In contrast, in the model used here, firms take the full price of travel as given. The problem is now to explain why this should be the case in competition. One answer is that in this model demand depends on the full price so the analogy with competitive behaviour in markets where there is no quality variation is that competitive firms here should take the full price as given.

More support for this view of the nature of competition in airline markets is available. The approach is to show that when firms take their rivals' money price as given, zero profits may be the result but that this outcome is unlikely to be an equilibrium. This result suggests the model where money price is taken as given is not a useful description of competitive behaviour.

Consider the full price of travel

\[ P^* = P + d(t) \]

---

1 The firm's problem is to choose \( P \) and \( t \) (average passengers per flight) to maximise \( Pt \) subject to \( P+E = C \) where \( C \) is a constant and \( P+E \) is the full price. The Lagrangean (\( L \)) and first order conditions are

\[
L = Pt + a(P+E-C) \\
t + a = 0 \\
P + aE_1 = 0
\]

from which \( P=tE_1 \) and since \( t = T/F \) and \( D_T=E_1/F \) then \( P=TD_T \).
where $P$ is the money fare and $t$ is passengers per flight. Each flight corresponds to a different firm. Full price contours can be drawn in $(P,t)$ space; their slope will be negative and becoming steeper as $t$ increases.\footnote{Some contours are illustrated in Figure 3.1.}

Assume initially that all firms are charging the same money price $P_1$ so total traffic is equally divided between all flights ($t_1$ each). The full price is $P^*_1$. The next step is to add a rectangular hyperbola as an iso-revenue curve ($R = Pt$). When firms take the full price as given they will choose $P$ and $t$ to maximise revenue subject to that constraint. In Figure 3.1 the solution to this problem would be to move to point B. Suppose that revenue corresponding to contour marked $R_2$ equals cost per flight then at B profits will be positive. Entry will then occur lowering the full price so that optimal fares will have to be recomputed by each firm. This process continues until zero profit equilibrium is reached at point $C$.\footnote{This description omits one part of the adjustment process for simplicity. In the shift from $A$ to $B$ firms' expectations may not be fulfilled and the full fare may fall, leading to another adjustment in money fares even before entry occurs. The question of whether entry leads to optimal frequency is examined below.}

This process can be compared with the other where firms take their rivals' money fares as given. For example let the starting point be $A$ then one firm considers cutting its money fare. It assumes other firms will hold constant their money fares at $P_1$ but

\begin{align*}
\frac{dP}{dt} & \bigg|_{P^*=P^*} = -d' < 0 \\
\frac{d^2P}{dt^2} & \bigg|_{P^*=P^*} = -d'' < 0
\end{align*}
Figure 3.1 Competitive Process
it knows that after all adjustments, the full price of travel must be equal on all flights. The implication is that the cutter will perceive his set of opportunities to be those along a line like AD. This line is steeper than the slope of the full price contour. The reason is that as the price cutter lowers the money fare, and attracts new customers, loads on rival flights will fall so lowering their full prices and reducing the attractiveness of switching to the cutter. The price cutter will choose a point on this line where revenue is maximised (point D). Other firms would be expected by the price cutter to be shifted to E where the full price is equal at E and D. Since the opportunity line AD is steeper near A than the full price contour it is expected that given the shape of the iso-revenue contours, the solution D will be at higher money fare than B.¹

In competitive markets all firms adopt the same strategy and try to move to D. Their expectations may not be realised in which case they recompute their money fares. The characteristic of the solution will be tangency of an iso-revenue contour and an opportunity line like AD. If profits exist at this outcome entry will occur and the final solution will lie on the zero profit iso-revenue line. But because of the use of lines like AD this zero profit solution need not lie at point C. In other words, only by chance will the second competitive mechanism minimise the full cost of travel, given zero profit. In that case the final solution will not be an equilibrium; all firms could be undercut by another

¹ This result is more formally derived by Panzar (1979b).
offering a lower full price and the new competitor can still earn non-negative profit.

The result that competitive utilisation of capacity is optimal is an old one (see Knight, 1924). An explanation of the result is the following. Say access to the air transport facility is free then utilisation will expand to the point where the last passenger is indifferent to making a trip or not. This decision will be based on average delay which is faced by the individual traveller. But this solution is inefficient. The reason is that a traveller can be removed from the system, that traveller will be no worse off but congestion will be reduced so other travellers would pay a premium to remain in the facility. The premium is a measure of the gain. Now take away another traveller and raise the charge to the remainder. This change will be an improvement as long as total revenue is higher. Thus passengers should be removed as long as the aggregate premium paid by the remainder goes on increasing. The optimum occurs at the point where revenue is maximised which is precisely the competitive solution. Effectively, private ownership of the facility causes the congestion externality to be internalised; or as Kay (1979, p.604) says, "the profit maximising position would be identical if congestion costs were borne by the supplier rather than by consumers".

Utilisation of existing capacity will be optimal in competition, but profits may be earned, which will attract entry of new firms so capacity will expand. As capacity expands, the pricing rule will be adjusted so utilisation continues to be optimal. Entry continues until profits are zero, that is,

\[ PT(P,D(T,F)) - kF = 0 \]  

(29)
Substituting for $P$ in (29) it can be shown, using the definition of $a$ (from (21))

$$k = aT/F - TD_F$$  \hspace{1cm} (30)

Hence if $a = 0$, competitive frequency will be optimal (see (26)). When $a$ is negative $k$ will be less than $-TD_F$ and, assuming $D_{FF}$ is positive so $-TD_F$ decreases with $F$, competitive $F$ is less than optimal. The important result is that the coincidence of optimality and competition depends on the characteristics of the delay function.

In summary, air transport is provided in lumpy units (flights) which can be thought of as jointly shared but congestible facilities. The optimal money fare is therefore a congestion toll. Increased capacity creates benefits for all travellers by reducing congestion and, in the general case, revenue raised by the congestion tax may not be sufficient to cover the cost of optimal

---

1 The monopolist's choice of $P$ and $F$ will be characterised by the following conditions

$$\frac{dT_P}{dP} = 0$$

$$PT_F - k = 0$$

The monopolist's price will be (28) above and since entry restriction implies the value of $e$ facing the monopolist will be low, $P_m$ exceeds the optimal toll and output will be too low. But it can be shown that, from the condition for profit maximising frequency,

$$k = -TD_F$$

so that given $P$, the monopolist chooses the optimal frequency, whatever the value of $a$. These profit maximising conditions have been used by De Vany (1975) and by Olson and Trapani (1981) to derive loci of price and trips and of price and capacity which can then be used to predict the effects of regulatory rules which have been hypothesised to characterise US domestic civil aviation regulation. These models are reviewed in Chapters 9 and 10.
capacity so a subsidy would be required. In a special case where the degree of homogeneity of the delay function is zero, no subsidy is required.

When all consumers have identical evaluations of delay, competitive firms in air transport markets were shown to charge the optimal toll given capacity. Competitive frequency will be optimal when the conditions for a zero profit optimum are met. This condition can be expressed in three equivalent ways:

1. The delay function is homogeneous of degree zero in frequency and total trips;
2. Delay depends only on load factors;
3. There is no direct effect of changes in frequency on stochastic delay and frequency delay is zero.

3.5 STROTZ PARABLE ILLUSTRATED

Let Q be passengers per flight then in the case where only one flight is available (so Q = T), total cost (C) will be

\[ C = k + dQ \]

Average cost (A) and marginal cost (M) are then

\[ A = \frac{k}{Q} + d \]
\[ M = d + QD_T \]

These functions are depicted in Figure 3.2. Also shown is average variable cost (V) which is equal to d.

The relationship between these functions is the following. M cuts the $ axis at \( d_0 \), equal to frequency delay imposed by the existing number of flights. As Q rises, congestion increases so d

---

1 This assumption is relaxed again in Chapter 4.
Figure 3.2 Cost Curves
rises as shown by the rising $V$ curve. The gap between $M$ and $V$ curves is $QD_T$, the marginal cost imposed by an extra traveller. The slope of $A$ is given by $-k/Q^2 + D_T$ which is zero when $QD_T = k/Q$, that is, when $M$ cuts $A$ at $A$'s minimum. At that point (C), the distance $BD$ is equal to $d$ and $BC$ is equal to both $k/Q$ and $QD_T$.

The next step is to derive the long run average cost function. This envelope can be derived by solving the problem

$$\text{Min } kF = Td_F$$

where $T = T$

and in that case

$$k = -TD_F$$

The envelope curve (LA) and the corresponding marginal curve (LM) are then

$$LA = d - FD_F$$

$$LM = d + TD_T$$

and

$$LA - LM = -(FD_F + TD_T)$$

$$= -a$$

If $D$ is homogeneous of degree zero then $a = 0$. When $a$ is negative, the LA curve always lies above the LM curve which means long run average cost falls as $T$ increases. The explanation of this result is that LA is the envelope of a series of short run curves. The short run curve for a particular frequency is the horizontal sum of $A$ curves for a single flight (like that in Figure 3.2). But as $F$ increases, the curve for one flight falls because the $d_0$ intercept decreases as frequency delay decreases. When $a < 0$ this effect dominates the congestion effect of more travellers and therefore the envelope curve has a downward slope.
The optimal toll is equal to the marginal cost which the extra trip imposes on other travellers. In this model, the optimal toll is therefore \( TD_T \). Hence the LM curve is equal to the average delay plus the optimal toll and can be interpreted as the full price schedule when the optimal toll is charged.

The LA and LM curves plus the demand curve (D) are drawn in Figure 3.3. Demand is, in this special case, assumed to be a function of the full price of travel \( (P + d) \). Optimal T (denoted \( T^* \)) occurs where D cuts LM. Optimal F corresponding to \( T^* \) can be obtained from the LA curve as illustrated in Figure 3.3. Given \( T^* \), the optimal number of flights occurs when LM cuts M at E. The optimal toll is \( EG \), equal to \( TD_T \), which is less than \( k/Q \), equal, in Figure 3.2, to the difference \( (HG) \) between A and V. Hence revenue from the optimal toll will not cover the resource costs of the optimal number of flights. The unit subsidy required will be \( EH \), the gap between LA and LM which was shown above to be equal to \( -a \). Hence the total subsidy is \( -aT \) but since \( T \) equals \( -k/D_F \), the total subsidy is \( ka/D_F \) as shown in Section 3.3.

As \( F \) and \( T \) increase it could be that the degree of homogeneity approaches zero. In that case \( TD_T = -FD_F \) and LA becomes flat and equal to LM. Therefore

\[
T(TD_T) = kF
\]

Since the left hand side is total revenue, profits at the optimum will be zero.

---

1 This diagram is similar to Figure 1 in Mohring (1972). Some differences are that Mohring did not include a demand curve in his figure. Mohring discussed congestion but it is a type different from that discussed here; in Mohring's bus system, stopping to pick up an extra passenger imposes delay costs on people already on the bus. Mohring says (in footnote 7, p.594) that he ignores the stochastic nature of demand.
Figure 3.3 Optimality
The competitive case is illustrated in Figure 3.4. Competitive output is $T_c$, competitive price is equal to $BC$ and the full fare is $BT_c$. Optimal output is $T^*$ which exceeds competitive output and implies a higher frequency. The competitive solution minimises average cost given capacity; in other words, competitive utilisation of the available facility is optimal. If the homogeneity of the delay function is zero, LA will correspond to the locus of the minimum points of the A curve which are the competitive solutions. In this case, competitive frequency will be optimal.1

3.6 CONCLUSION

There were two main results of this chapter. Firstly, the possibility that optimal air fares and flight frequency could involve non-zero profits was confirmed. The source of this divergence was found to be the presence of two externalities; a negative congestion externality generated by the extra trip and a

1 This is another convenient point to make comparison between Dorman's (1976) results and those obtained here. Dorman uses a series of iso-revenue, iso-cost (of capacity) and iso-full price contours in $(P,d)$ space to compare the results of competition and optimality rather than the more familiar diagrams used here. In Dorman's model of competition a traveller first chooses a firm then among that firm's flights, whereas here a traveller only chooses among flights. Dorman justifies his assumption on the grounds of search costs. Dorman derives a result analogous to the case of a declining LA curve when 'a' is negative but given his specification of the nature of competition, he is then led to conclude this case implies a natural monopoly. Subsequently he argues, a zero value of the parameter 'a' is a necessary condition for the market to be competitive. On the contrary, it is shown here that the market can still be competitive even though LA is not flat. A zero degree of homogeneity of the delay function is actually a necessary condition for competitive frequency to be optimal. If search costs are important they could be incorporated but as another dimension of service quality. Dorman limits his discussion of competition to the case where a single firm provides all flights.
Figure 3.4 Competition
positive external effect generated by an extra flight. While revenue can be raised from an optimal congestion tax, it need not be sufficient to cover the costs of the optimal number of flights.

The second result was that it is also possible that competition can provide the optimal number of flights. This occurs when the delay function is homogeneous of degree zero. This result has a number of interpretations. For example, it implies frequency delay of zero and changes in frequency have no effect on stochastic delay. Equivalently, it means that delay depends only on the load factor.
CHAPTER 4: THE SERVICE QUALITY CASE FOR REGULATION

4.1 INTRODUCTION

A result of the previous chapter was that the quality of service in competitive air transport markets may not be optimal. Market failure of this type was emphasised in a recent report of a government committee of review of Australian international civil aviation policy (ICAP, 1978) (referred to in Chapter 2). In the report, the case for continuing regulation was, in part, based on this market failure argument. The relevance of the service quality case requires critical evaluation and the aim of this chapter is to review this aspect of the ICAP Report. The conclusion is that, while the authors of the report raised an interesting source of market failure, the service quality argument for regulation is not relevant in international civil aviation.

Of course, there are many components of the quality of service in air transport but only one dimension is of concern here. It is that aspect determined by flight frequency and average load factors of aircraft. The reasons why these characteristics have value for consumers were discussed in Chapter 3. The source of interest in these characteristics of air transport is evident in events preceding commissioning of the Report, particularly the reaction of the Minister of Transport to a Laker entry bid, discussed in Chapter 2.

The Committee's Report contains discussion of a number of institutional constraints to policy making, in particular the use of bilateral agreements to implement policy. These institutional

---

1 Parts of this chapter are from Findlay (1982).
topics are ignored in this chapter\(^1\) since, as the authors of the ICAP Report point out, discussion of the market failure arguments can proceed independently of institutional arrangements (ICAP, 1978, para. 3.2.11, p.63).\(^2\) The view is taken here that in the absence of regulation, air transport markets would be competitive. Arguments that in the absence of regulation these markets would not be competitive, for example, because of alleged scale economies, are discussed in Chapter 6. This chapter is solely concerned with an assessment of the service quality type of market failure argument in the ICAP Report.

Since the economic argument for regulation in the ICAP Report concentrates on market failure, the approach adopted here has been to develop a model that can be used to generate and compare competitive and optimal solutions. Comparison of these outcomes will indicate whether the market failure arguments are justified. The technical aspect of this exercise of development and manipulation of the model was reported in the previous Chapter. In this Chapter, the results are applied to the arguments of the ICAP Report. Implicitly, the authors of the ICAP Report also used a model to define their view of an optimal air transport system and to predict the competitive solution. An attempt is made to make their model explicit and to compare it with the model used here.

The plan of this chapter is that the Committee ideal, apparent in discussion in the Report, is described in the next section. In subsequent sections the results of the model of Chapter 3 are applied to arguments in the Report.

---

1 See Chapter 5 for discussion of 'the impossibility of unilateral action'.

2 All future paragraph and page numbers refer to ICAP (1978).
4.2 THE ICAP IDEAL

Characteristics of the ideal air transport system of the ICAP Report were a high utilisation of capacity, maintenance of service quality, in particular, availability of seats at short notice (or "on demand"), use of flexible ticket types to accommodate the goals of high loads and availability of on-demand seating, and a second-best policy of price discrimination with prices set to break even. These characteristics are discussed in this section.

In its initial discussion of capacity utilisation and regulation, the Committee noted the cost advantage of a charter operator who "is able to have all seats occupied on an end-to-end basis over the route flown" (Para. 1.8.1, p.28). The Committee then observed that the current regulatory environment had generated load factors that were too low (Para. 2.2.12, p.45) but the Committee was not led to abandon regulation because of this result. It wrote:

"it is Australian policy that, by pre-determining capacity at a level only modestly in excess of the anticipated demand for travel, the carriers' unit cost of production falls as unutilised capacity is reduced, and total resource utilisation is improved. Government intervention, already present, is required to ensure that the benefits are not retained by the producer, and that consumer benefit is reflected in lower fares" (Para. 1.8.3, p.29).

This comment says that the correct response to a failure of current regulation is more effective regulation. In particular, the policy suggests one response the Committee had in mind was to export the 'Two Airline Policy',¹ that is, monopolisation of each route

---

¹ See Kirby (1981) for a recent review of domestic civil aviation policy. It should be emphasised the Report only reviewed policy options and did not make recommendations.
by cartels of end-point-country carriers where monopoly power was to be both enforced and limited by government regulation (see Chapter 2).

The preoccupation with capacity utilisation reflects an interest in achieving high loads thus lowering average cost per passenger and creating the opportunity for lower fares for some passengers (Para. 2.1.4, p.39). Predetermining capacity modestly in excess of demand could require reduction of frequency of service, which would lower capacity costs per passenger. But reducing frequency has the offsetting effect of lowering the quality of service. The reason is that aspects of service quality of interest here are indexed by delay, interpreted as both time wasted and inconvenience, and comprising frequency and stochastic delay (see Chapter 3). Frequency delay obviously increases as frequency decreases. In terms of the characteristics of the Committee's ideal, a higher average load factor reduces the extent of 'on-demand' seating, that is, it lowers the probability of getting a set on a particular flight at short notice.¹ Thus lowering frequency, and subsequently raising load factors, will also lower service quality.

The Committee was also aware of these aspects of service quality. It emphasised the values of a scheduled service (Paras. 2.2.6 - 2.2.8. p.43) and of "on-demand" service. It quoted a UK Inquiry which

---

¹ The Committee was aware of the mechanisms of stochastic delay, in particular, that demand at a particular time is stochastic (Para. 3.3.6, p.66) and that the probability of having to wait rises with the load factor (Para. 3.2.5, p.60).
"described the demand for regular scheduled 'on demand' services as involving collective demand in the sense that a significant proportion of the community could be expected to take the view that it should be available if they wished to use it. It is this collective or more precisely option demand feature, plus the fact that the operator of a scheduled service is vulnerable to 'ad hoc' competition, that has led to general agreement that the obligations of public service should be matched by some degree of protection for, or assistance to, the scheduled operator."
(Para. 2.2.9, p.44)

Subsequently, the Australian Committee argued

"It is not clear that the resolution of the interdependence between the range of qualities of service and fare levels ... by (a) relatively unconstrained process leads to the most desirable mix of service offerings... especially when the 'option demand' aspect of higher quality fare types... is recognised." (Para. 3.2.9, p.62)

A "relatively unconstrained process" can be taken to refer to competition.

The Committee's ideal, so far described, seemed to be that air transport should be provided by scheduled services with sufficient on-demand seating but with a high load factor. These goals of high loads and on-demand seating could be reconciled, according to the Committee, by sale of tickets that serve a "fill-up role" (Para. 3.4.12, p.76) such as advance purchase or standby tickets. Thus the Committee appeared to by trying to reconcile the interests of some travellers in lowest possible fares and the interests of others "whose principal consideration when deciding to travel is not lowest price" (Para. 2.1.5, p.39).

The ICAP Committee was also concerned with the fares charged for different types of ticket. The principle adopted by the Committee was that fares should be "cost-based". The appropriate cost to be applied in fare formulas, was according to the Committee, the marginal resource cost. This meant that on-demand passengers
should bear all capacity costs, since their preferences determine frequency, while "fill-up" passengers should pay a fare close to zero (Para. 3.4.12, p.76). But, the Committee noted, this structure was not commercially viable. Under these circumstances

"...it is appropriate, in terms of economic efficiency, for the total capacity costs to be shared by all passengers, where the shares are related to the demand sensitivity for the particular service types provided. Specifically, the share of capacity costs attributed to each fare type should be greater the lower the price sensitivity of demand associated with the fare type.

Quite obviously, this approach is based upon price discrimination. The passenger market is segmented into sub-markets that are defined in terms of, and (partly) insulated from each other by, service conditions. The different fare elasticities of these sub-markets are then utilized to determine the share of capacity costs and the appropriate level of fares." (Paras. 3.4.14-15, pp. 77-78).

The Committee was able to justify ticket restrictions on the ground that effective price discrimination, which it advocated,

"may require that the interdependence (cross elasticity) between certain fare types is tempered by the addition of certain travel conditions that are not necessarily directly related to airline resource costs. For example, minimum and maximum stay conditions, tied ground packages, return trip requirements and restricted seat capacity are appended to the fare conditions of most lower fare services, for example, those requiring advance purchase, in order to segment the market more sharply, allow a basis for sharing capacity costs, limit conversion and maintain the viability of other higher fare services". (Para. 3.4.16, p.78)

In summary, the ICAP ideal was scheduled service with on-demand seating as well as a high load factor, made possible by sale of flexible tickets. Prices, ideally cost-based, generally would have to be discriminatory but set to break even. Further, the Committee argued, or its views implied, regulation was required. According to the Committee, effective regulation was needed to
control capacity and the market could not be relied upon to provide the appropriate mix of service quality. Finally, discriminatory pricing, advocated by the Committee, could have to be supported by regulation. ¹

The results of the model of Chapter 3 can now be applied to review the ideal of the ICAP Report and the case for regulation. It is convenient to group these arguments under the headings

1. capacity and utilisation
2. on-demand service
3. fare structure

4.3 THE ICAP ARGUMENTS

4.3.1 Capacity and Utilisation

As indicated in the discussion of the ICAP ideal, the authors of the Report were concerned with choices of flight frequency and utilisation of capacity. Their view appears to be that the market, taken here to be competitive, cannot be relied upon to generate optimal solutions. On the contrary, the results of the Strotz model are that competitive utilisation of capacity will always be optimal although competitive frequency will be too low when optimality requires negative profits. But when optimality requires zero profits, competitive frequency will be optimal. ²

¹ This statement is qualified because of the results of the literature on sustainable monopoly, discussed in Section 4.3.3.

² The model from which these competitive results are derived assumes travellers have identical evaluations of delay. In a more general model where consumers' evaluations differ, the market will set price and quality according to the evaluation of the marginal consumer but it is the evaluation of the average consumer which counts for optimality (Spence, 1975). The marginal consumer will tend to put a lower evaluation on
The question is then whether conditions for a zero profit optimum are likely to be met on international routes? There are a number of reasons for expecting an affirmative answer.

Douglas and Miller (1974, ch. 6, appendix) have estimated frequency and stochastic delay functions using data from the U.S. domestic market. These estimates, discussed in the Appendix to this Chapter, where relevant data are also reported, indicate the cost of frequency delay is relatively low and that the direct effect of a change in frequency on stochastic delay is also small. The result is that, for the range of daily frequencies reported in the Appendix, the conditions for a zero profit optimum could hold approximately.

On some routes, frequencies may be much lower than the range over which the Douglas and Miller results apply. For example, on international routes, frequencies could be as low as one flight per week, although not to major destinations. In that case the valuation of frequency delay and of the reduction in stochastic delay due to the extra flight could be very high. On the other hand it can be argued that the value of delay falls with length of delay and with the length of the trip (Forsyth and Hocking, 1978, pp.3-4). The reason is that people may be able to rearrange their activities for such journeys. Hence for low frequency, long distance routes, the conditions for a zero profit optimum may also hold approximately.

2 delay so competition may lead to excessive use of the (cont) facility and the result that competitive frequency will be too low, even if travellers are identical, may be reinforced. Mechanisms for coping with differing evaluations of delay are discussed in Section 4.3.2.
Further support for the argument that on international routes, the competitive solution is likely to be optimal follows from the "windows", or limited range of departure times, available due to airport curfews and international time differences. Within these narrow ranges, the point where extra flights have an insignificant effect on delay via the gap between departures is likely to be reached quickly.

In summary

(i) it is possible that competitive frequency will be sub-optimal but utilisation of capacity will never be sub-optimal in competition.

(ii) there are conditions in which the competitive capacity will also be optimal. These are (a) identical evaluations of delay and (b) the delay function homogeneous of degree zero. Condition (b) is expected to be a reasonable approximation for international routes.  

4.3.2 On-demand service

The authors of the ICAP Report emphasised the value of on-demand service, one aspect of which is the choice of capacity and its utilisation which has been discussed. The problem raised by the Committee can be interpreted as follows. Air transport is provided in lumpy units which can lead to delay. When more people wish to fly than there are seats available, some must be made to wait. In

---

1 Adopting this condition in combination with constant unit cost of frequency means that optimal club size is indeterminate (see Berglas and Pines (1981) and Sandler and Tschirhart (1981)). In hindsight this result provides a justification for ignoring the choice of optimal club size (I) in the maximisation problem of Chapter 3.
this situation, the rationing problem is to ensure that, when
evaluations of delay differ, those who most value the trip are
enplaned. In other words, the mechanism which generates the
stochastic delay must minimise the cost of delay. This is
equivalent to saying there should be an "on-demand" facility for
travellers who put a high value on a particular flight.

Two mechanisms which could be imagined will achieve the
desired seat allocation are an auction or random allocation of
transferable tickets. While these two mechanisms are plausible,
they are not likely to be efficient. The first reason is that they
involve high transactions costs, particularly time. The second
reason is that these mechanisms, in the absence of compensation
payments, will not provide the advantages of a seat held with
certainty. It might be argued that this second reason is not
relevant because travellers would be able to insure against failure
to obtain a ticket. But insurance markets are not likely to be
perfect because of the presence of moral hazard; insured people will
have less incentive to minimise the costs of failing to get a seat.

Another mechanism, which offers lower transactions cost
than the first two mechanisms, was proposed by Vickrey (1972) and
called a "simulated speculators market". Vickrey suggested airlines
sell reservations on future flights at prices which would reflect
the outcome of a competitive futures market in those reservations.
The price at any given time "would be such as to generate an
expectation that, if the price were kept constant at this level, the
remaining seats would just be sold at flight time" (Vickrey, 1972,
p.258). Thus the Vickrey proposal is for trade in seats in advance
of departure time. Vickrey, who provided a detailed account of the
operation of his scheme, claimed it "should make it possible to achieve load factors of 0.85 up to 0.95 and possibly higher, while at the same time almost eliminating instances where a passenger urgently wanting to travel on a given flight finds that it is sold out" (Vickrey, 1972, p.259). Such a result would fulfil the goals of the ICAP Committee reported above.

Yet another device, simpler than the Vickrey scheme but not likely to be as effective, is to offer a variety of tickets which are characterised by the probability of getting a seat. Tickets offering a high probability will command a high price and people with a high valuation of the flight will purchase these tickets. Thus consumers will tend to rank themselves by revealing their valuations through preferences for different types of tickets.¹

Nagarajan (1979) says "no one would argue that (this type of booking scheme) is suitable as the exclusive form of reservation available" (p.112). The reason he offers is that passengers always prefer definite reservations and conditional reservations are likely to increase passenger anxiety, encourage multiple reservations and encourage the "no-show" problem. Comments on this argument are first that it underrates the ability of travellers to cope with

¹ It might be thought there is some conflict between use of this mechanism and the earlier argument that a mixed club for transport services is optimal. It remains true that mixing is appropriate but now there is an additional mechanism for differences in preferences to be reflected. The desirability of mixing does not mean that large market segments could not be provided for by specialist carriers (like a Laker Skytrain service). But if all segments were catered for by specialists the advantages of scale economies in frequency to each group could be diminished. Therefore specialist carriers, most likely catering for people who put very low value on delay, could be observed co-existing with a scheduled and mixed service.
uncertainty. The sale of standby tickets on Australian domestic routes indicates Australian travellers are willing to take a chance. Second, multiple reservations and the "no-show" problems are exacerbated by the absence of a booking fee.

It is possible to incorporate a booking system, with tickets characterised by the probability of getting a seat, in the Strotz model. But first, it is necessary to ask whether competitive markets will offer some type of rationing device. The comments of the authors of the ICAP Report, on the need for government intervention to ensure on-demand seating is available, indicate their answer would have been 'no'. But competitive firms will offer some kind of rationing device because it is profitable to do so. The competitive implication is that a firm not providing some solution to the rationing problem would lose its business to a firm that did so.

A complex model could explain travellers' choice of ticket type when a range was available. This choice will depend on the value of the trip, the fares, the seating probability and attitudes to risk. Here this choice is taken as given. It is assumed travellers comprise two homogeneous groups. In the simplest case, there would be just two types of tickets which can be thought of as normal and standby. Normal ticket holders have a high seating probability while standby travellers do not. Seating probability depends on total traffic and capacity. This type of ticket system can be incorporated into the Strotz parable.\(^1\) Delay functions vary between types of travellers. Delay for standby type depends on

---

\(^1\) Consider the special case of the utility function where there are two types of travellers. Type 1 travellers, indexed by \(i\), have a delay function \(D^1\) and type 2 travellers, indexed by \(j\), have a delay function \(D^2\). It is assumed that for the
trips of both types and capacity but delay for the other type depends only on trips of that type and on capacity. The first result of the model is that normal passengers should pay a toll reflecting the marginal costs they impose. These costs include delays to both their own type and to standby travellers. The latter pay a lower fare because they impose delays only on their own type and not on normal-fare-paying customers.

Other results are that optimal frequency depends on the valuation of the benefits of increased frequency by both types of passengers and that a sufficient condition for zero profits at the optimum is that both delay functions should be homogeneous of degree zero. This condition could reasonably be assumed to apply to standby passengers who have a low valuation of waiting time. In that case a necessary condition for zero profit optimum is that a normal traveller's delay function be homogeneous of degree zero. Applying the earlier argument about such a delay on international

\( \text{same } T \text{ and } F, \ D^1 > D^2. \) Group sizes are I and J respectively, and travellers within each group are homogeneous. Then it is assumed there are two types of tickets available: one type is called normal which offers a high probability of obtaining a seat and the other is called standby, which offers a lower probability. Next, it is assumed that type 1 travellers always buy normal tickets and type 2 travellers always buy standby tickets. The delay to type 1's depends only on trips by type 1 travellers and can be written

\[ D^1(T^1, F) \]

where \( T^1 \) is total type 1 trips. Type 2 delay depends on trips by both types and can be written

\[ D^2(T^1 + T^2, F) \]

Hence the Lagrangean for the optimality problem is

\[
L = \sum_{i=1}^{I} w^i [u^i(t^i, x^i - t^iD_1(.)) - c^i] \\
+ \sum_{j=1}^{J} w^j [u^j(t^j, x^j - t^jD_2(.)) - c^j] \\
b(x=X(R=KF))
\]
routes, this is also a reasonable assumption. It is concluded that a zero profit optimum is likely in this case of two ticket types. Finally a competitive firm always charges the optimal tolls to both ticket types and if both delay functions are homogeneous of degree zero the competitive frequency will also be optimal.

In summary of this section, there is a gain from ensuring an efficient allocation of seats on a flight for which there is excess demand, but a number of mechanisms can be imagined which will solve this problem. One of them is a competitive solution, involving the sale of two ticket types, normal and standby. These mechanisms have not been described in detail but presented to illustrate the point that there are rationing devices which are consistent with competitive markets, and which allow for differing evaluations of delay between travellers.

4.3.3 Fare Structure

The previous section discussed a pricing scheme in which both on-demand and standby travellers paid a congestion toll. On the other hand, the ideal pricing system described by the Committee seems to contain no significant element of pricing for congestion. In the Committee's ideal standby travellers pay a fare close to zero, under the rule used by the Committee to allocate costs of capacity. On-demand travellers, under the ICAP ideal system would pay for capacity. Thus the Committee's pricing rule can be interpreted as a device for raising revenue to cover the costs of capacity. It is not evident that raising the revenue this way, by a tax specific to a sub-set of air transport consumers, is the least cost method of financing the subsidy. Nor is it likely that congestion tolls of zero are appropriate since that would imply zero
congestion was optimal, which would imply enormously high evaluation of delay by some travellers.

The Committee argues its ideal fare structure would not be commercially viable because all the travellers would opt for the tickets with zero price. Thus the airlines could raise no revenue. But the market response to this structure would be to reduce capacity, create some congestion and introduce one or more of the devices discussed in the previous section to solve the rationing problem.

Using the insights from the Strotz model, it is evident the source of the Committee's pricing rule was its narrow definition of marginal cost. To illustrate, take capacity as given then flights are a facility to be jointly shared by a group of people. The marginal cost emphasised in the model used here is the delay or inconvenience imposed on others by one person's decision to travel. Some congestion will be present in the optimum, which leads to a set of tolls that, under reasonable assumptions about the delay function, generates enough revenue to cover the costs of capacity. Thus price discrimination, as proposed by the Committee in the absence of commercial viability of its ideal, is unnecessary.

This is an appropriate place to refer to the literature on sustainable monopoly (see, for example, Baumol and Willig (1981) and Baumol, Bailey and Willig (1977)), since it further clarifies the character of the model implicit in the ICAP Report. This literature emphasises a cost function characterised by economies in scale and in multi-product output. (The latter could be interpreted as provision of different service qualities to passengers on the same aircraft). An implication is that cost minimisation calls for only one seller, which could be the case on small (or 'thin') routes.
Alternatively, the model could be thought of as applying, not to a schedule, but to one flight. Hence the model used in this literature has some features relevant to civil aviation.

A result of this literature is that there may not always exist a set of prices (called sustainable) which will sustain the monopolist against entry. A necessary (although not sufficient) condition for such prices to exist is that the cost function have the characteristics described in the previous paragraph. When sustainable prices exist, a set that will always sustain the monopolist must satisfy the Ramsey conditions for a welfare maximum subject to a profit constraint (zero when there are no entry costs). This price structure corresponds to the ICAP second-best fare structure, but in the sustainable monopoly model, does not require regulation to bring it about.

Hence the ICAP proposal corresponds to a market solution emphasised by the literature on sustainable monopoly. But, the model from which this result is derived is limited in application to civil aviation, because it ignores congestion. This is evident when Baumol and Willig (1981) point that the case of pure public goods can be incorporated into their model. On the other hand, the model reported in Chapter 3 is that of provision of a congestible joint good (or 'impure' public good).

Another point is that even if a variety of ticket types are available, as a device for rationing seats in times of excess demand, the preferences of all travellers are relevant for determining capacity, as reported in the previous section. (The Committee, as reported in Section 4.2, had argued only 'on-demand' preferences count.) But each type of traveller pays a different toll, depending on the delay imposed on others.
At one point, the Committee argues that all potential passengers who value on-demand seating should contribute to the costs of its provision (Para. 2.2.9, p.44). The Committee argues that if scheduled services become "seriously jeopardised", the Government would need to consider a subsidy, financed by public funds, for air transport. But this mechanism is unnecessary. On the expectation that a flow of passengers will continue to demand access to flights at short notice and be willing to pay a premium for the privilege then it must be concluded profit seeking carriers will continue to make available a mechanism for satisfying that demand.

In summary, the ICAP resource marginal cost pricing rule is not a helpful way of approaching air ticket pricing. A more insightful method is to think of air transport as a facility jointly shared but congestible. Optimal fares are then congestion tolls which under likely conditions on international routes generate enough revenue to cover the costs of the facility of optimal size. In other words, such fares are both cost-based and commercially viable.

The ICAP Report contains some discussion of peakload pricing. The peakload problem occurs, for example, when capacity is fixed in two periods between which there is a seasonal or cyclical variation in demand. The Committee said, ideally,

"pricing of air services requires that capacity costs should be borne by peak demand since it is this demand that determines (at the margin) system capacity" (Para. 3.4.20, p.80).
In terms of the Strotz model, this rule is a special case. Given the presence of stochastic variation in demand, it could be that at some points in the off-peak period, demand is as high as in the peak period and some passengers are delayed. Given the presence of congestion in both periods, the result of the Strotz model is that passengers in both periods should pay a toll and that preferences of all travellers should be taken into account in determining capacity. If the delay function is homogeneous of degree zero, revenue raised over the two periods covers the total cost of optimal capacity.

The ICAP rule implies zero congestion in the off-peak period. It is an empirical question whether this condition is satisfied.

Assume that demand varies seasonally, as well as stochastically, but capacity is fixed. In that case, the problem is that of peak load pricing discussed by Williamson (1966) and others. Optimal prices and capacity can also be derived using the Strotz model. An individual's utility function is now

$$U^i = U^i(t^i_1, t^i_2, d^i_1, d^i_2, x^i) i = 1...I$$

which depends on trips in the two periods, assumed to be of equal length, and delay which varies between periods due to differences in total trips while frequency (F) is held constant. The Lagrangean is now

$$L = \sum^i (U^i(t^i_1, t^i_2, d^i_1, d^i_2, x^i) - c^i)$$

$$+ a_1(d^i_1 - D(\Sigma^i t^i_1, F))$$

$$+ a_2(d^i_2 - D(\Sigma^i t^i_2, F))$$

$$+ b(\Sigma^i x^i - X(R - 2kF))$$

The subscripts 1 and 2 are here interpreted as different time periods but they could also be different directions on the same route.
likely but the conjecture here is that it will not hold.¹ The Committee went on to argue that its ideal peakload pricing was not possible so discriminatory pricing, where fares varied according to the elasticities each season, was appropriate. Similarly, it argued the "backhaul problem" could be handled by "appropriate price discrimination by taking into account the fare elasticities associated with each direction of travel and/or developing round trip fares" (Para. 3.4.22, p.81).

The optimal fares for the backhaul problem, as indicated by the Strotz model, will have the same characteristics as those for peakload pricing. The fare structure proposed by the Committee is the type of structure a monopolist would apply. On the other hand, the Strotz fares will be generated by competition, just as the fixed costs of facilities jointly used over two periods can be efficiently allocated by market mechanisms according to aggregate demand each period.²

It is of interest to apply the results of the Strotz model to pricing rules for journeys with multiple stops. Currently, a traveller on such a journey may be charged a 'through' fare perhaps with a stopover surcharge. If carried by different airlines on each sector of the trip, the 'through' fare is allocated between carriers by some proration rule which often results in revenue dilution, that is, the fare received by each airline is less than the sector fare. In other words, the through fare is less than the sum of the sector fares. Is this appropriate? No, since the Strotz model suggests

¹ The ICAP Report also presumes "limited opportunities...to shift capacity between markets" (Para. 3.4.20, p.80) and it is not clear that such opportunities are so limited.

² Consistent with this argument is the evidence that unregulated "discount" fare tickets tend to become available in off-peak seasons.
that the through fare should be the sum of the sector fares. On each leg the traveller should pay a toll reflecting the congestion imposed on other travellers.

The sum-of-the-sectors pricing rule can be applied to another aspect of the fare structure, which exercised the ICAP committee and later became an issue in the application of the new Australian policy; this was the question of a stopover surcharge (see Chapter 2). The Committee argued that the surcharge should be cost based, but the question is which costs are relevant? In terms of the Strotz parable, the stopover question can be examined in a model where there are two legs of journey and there is equal capacity on each leg. The optimal fares then depend on congestion on each leg and there is no reason why a traveller who breaks the trip should pay a higher fare for the first leg than the passenger who does not stop. They both impose the same congestion costs on that leg.

A response to this argument may be that when the passenger stops-over, the seat is left vacant which imposes a cost. But if the seat remains vacant, this may indicate the second leg is less congested than the first and so a lower fare for that leg is appropriate. It may then be argued that the through service is no longer viable but, if so, that indicates frequency may be too high. Optimal frequency will depend on traffic on both legs of the journey, and may need to be adjusted even if it means increased congestion on the first leg. The firm ground for arguing for stopover surcharges is that stopovers impose extra administrative costs on the airline.¹

¹ Some airlines claimed during the talks with ASEAN in 1979, the appropriate surcharge on this ground was $25. But if [contd]
Discussion of the stopover surcharge assumed that frequency on both legs of a two sector route was the same. This restriction may not be reasonable so that an alternative to lowering money fares on the less congested sector may be to cut frequency.

In the discussion so far, and in the model of Chapter 3, aircraft size was held fixed. Capacity was provided in lumpy units and the assumption of a single size of 'lump' was sufficient to generate the characteristics of the optimal and competitive solutions. Aircraft size is, however, not fixed and there is evidence of economies in size (Bailey and Panzar, 1981). The presence of this economy suggests there could be a trade-off between lower costs, due to greater aircraft size, and loss of service quality, due to lower frequency (Forsyth, 1981d). The direct effect of lower frequency will not be important when, as argued here, delay depends only on the load factor. It may be that on 'thin' routes the advantages of scale in aircraft size are such that the optimal solution occurs in the region where the delay function is no longer homogeneous of degree zero. A subsidy would then ideally be required. A second best solution may be to maximise welfare subject to a zero profit constraint, by using price discrimination. A conjecture, based on the results on the sustainability literature is that these prices may be charged by a monopolist subject to entry. This result is an interpretation of the conditions and market

---

1 stopovers occur at technical aircraft stops, which are also destinations for some passengers and where all passengers typically alight, the marginal costs of the stopover passenger would seem to be mainly the extra baggage handling of the extra trip into the hold to collect or deliver the bags of the stopover traveller. It would be surprising if this cost amounted to $25. The "discount" tickets available in 1979 and 1980, after the policy change of 1978, offered stopovers at no surcharge.
behaviour discussed in the Frank memo (Frank, 1980). Despite this possibility, the assumption of a delay function homogeneous of degree zero is maintained as a reasonable approximation for international routes.

The relevance of introducing variable aircraft size at this stage is that it facilitates discussion of optimal network characteristics, a topic suggested by the possibility of multiple stop journeys. For example, the full costs of travel may be minimised by feeding traffic through a central hub, using larger aircraft on sectors into and out of the hub. An extreme example would be to feed all Australian traffic through Singapore from where people would travel to Europe, North America or other points in Asia. In this type of case, the full fare would fall on both sectors of a journey. The lower cost per flight would lower the long run average cost curve (in Figure 3.4). The benefits, when delay depends only on the load factor, would be taken out as greater service quality and lower money fare. Frequency to a particular destination, via the hub, could even increase, reinforcing the judgement here of the characteristics of the delay function.

The cost advantages of larger aircraft would have to be traded off against longer trip times and delay at the change of aircraft. Even in the presence of a feeder service some travellers may be prepared to pay a premium to travel non-stop. In that case, a feeder and a direct service could both be available.

4.4 Conclusion

The ICAP ideal was classified under three headings of capacity and utilisation, service quality and fare structure. It is
concluded here that under each of these headings the competitive solution can be optimal.

Application of the Strotz model to the questions of optimal capacity and utilisation showed that when all consumers had identical evaluations of delay, even if optimality required negative profits, competitive utilisation of available capacity would be optimal. When optimality required zero profits, competitive capacity will also be optimal. A review of some U.S. data and the characteristics of international routes suggested the conditions for a zero profit optimum were likely to hold on those routes.

Consumers are likely to differ in their evaluation of delay and service quality which, it was argued, will tend to shift the competitive result toward excessive utilisation of capacity and insufficient frequency. But it was also argued that when evaluations differ, competitive firms would have incentive to cater for the varying degrees of intensity felt about delay by different travellers. In a simple system of two ticket types, where consumers ration themselves in periods of excess demand for available flights, it was shown that the competitive solution would be optimal, given the conditions for a zero profit optimum were satisfied.

In the two ticket system, fares can be shown to be cost based where cost refers to congestion created in the jointly consumed flight facility when extra passengers arrive. It was argued that the fare system proposed by the ICAP Committee was unnecessarily discriminatory.

In summary, the ICAP Committee raised some interesting problems and some possible sources of market failure, but further examination has shown they are not relevant as economic arguments in support of regulation of international air travel.
APPENDIX TO CHAPTER 4: ESTIMATING THE COST OF DELAY

The problem is to estimate the value of delay, as defined in the text, which will depend on its unit value and its length. The unit value is conceived of here as the private value of time. The estimate used is the before-tax (or 'gross') wage rate (of $6-12 in October, 1980, for non-managerial workers). For a number of reasons this figure is not expected to be an accurate estimate of the cost of a unit of delay.

The first is that travellers are more likely to, privately, value their time at the wage rate net of income tax. In this case, the cost of delay to passengers will be overstated by the gross wage rate. Second, delay is not only time wasted but also inconvenience, and the cost of latter is likely to be lower than that of time wasted, for example, due to the possibility of reorganising activities. Again, the cost of delay will be overstated by the gross wage. The third problem is that the distribution of earnings of air transport consumers may not match that of the whole community. If air transport consumers tend to have higher values of time, then use of the average (and non-managerial) wage rate will tend to underestimate the cost of delay.

Further evidence on the cost of delay is available from Nagarajan (1979), who, in a survey of passengers, at Buffalo Inter-

1 Complications introduced by taxation into the comparison of optimality, which strictly will depend on social value of time, and the market result, which will depend on private values, are ignored.

2 A preliminary and unpublished figure supplied by the Australian Bureau of Statistics (ABS). (See ABS, Earnings and Hours of Employees (Ref. 5304.0).)
national Airport which serves international and US cities, asked
them the amounts that would compensate them for waiting for the next
flight. Nagarajan's results were that "some people are willing to
wait for no compensation at all (and) (t)he median person seems to
be willing to wait for roughly five dollars per hour of waiting
time" (Nagarajan, 1979, p.114). Nagarajan argued that airline
passengers were likely to be relatively wealthy and predicted the
value of time to be the median US wage rate which he estimated to be
$US8 per hour. Nagarajan's results are interesting for two
reasons. First, accepting his estimate of the US median wage rate
(which exceeds the actual average gross hourly earnings of $US5.25
in 1977 and $US5.69 in 1978 (Statistical Abstract of the United
States, Bureau of the Census, US Department of Commerce)), and
accepting his prediction of the composition of the air transport
market, they suggest the value of time will be less than traveller's
gross wage rate. Second, his results show a wide range of
valuations of delay, indicating not all passengers put high values
on delay and supporting the relevance of systems for rationing seats
in times of excess demand for a flight.

There are two other comments on Nagarajan's result. First,
his sample included travellers of trips of different lengths. As
argued in the text, the cost of delay is likely to be higher for
shorter trips and so Nagarajan's estimates may overstate the cost
relevant for long-haul international routes. Second, Nagarajan's
estimate of the value of delay is close to actual average US gross
hourly earnings. But this does not necessarily justify use of the
corresponding Australian figure, since it could be the result of
offsetting errors.
Douglas and Miller (1974, Ch.6, appendix) have estimated both frequency and stochastic delay (in a model where the delay elasticity of demand was zero). Frequency delay was estimated using a particular time pattern of daily demand for flights. For a range of numbers of daily flights they determined a schedule of departures which equalised passengers per flight. For each daily frequency (F), average frequency delay (h(F)) was then calculated. Using these data Douglas and Miller estimated the relation

\[ h(F) = 92F - 0.456 \]

(where \( R^2 = 0.497 \)). Estimates of average frequency delay from this equation will depend on the time pattern of demand and the rule used to allocate flights. Douglas and Miller say these assumptions could significantly affect the delay function so that less confidence can be placed in estimates of the level of the function, which is important here, than in estimates of the effect of changes in frequency, which were of interest to Douglas and Miller.

Table 4.1 contains estimates of average frequency delay for the lower part of the range of daily frequencies, the cost of frequency delay, is relatively low. This conclusion seems likely to hold even if there were a significant understatement of frequency delay by the Douglas and Miller equation.

Douglas and Miller estimated stochastic delay using a queueing model of daily passenger traffic in US domestic markets in 1969. They varied demand and capacity parameters and estimated stochastic delay for each set of parameters. They summarised the data by estimating average stochastic delay as a function of seating capacity per flight (m), mean flight demand (Q), the standard deviation of passengers per flight (σ) and the average interval
TABLE 4.1: Estimates of Average Frequency Delay

<table>
<thead>
<tr>
<th>F</th>
<th>Timea (mins)</th>
<th>Value ($6.12/hr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>92</td>
<td>9.38</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>6.83</td>
</tr>
<tr>
<td>3</td>
<td>56</td>
<td>5.71</td>
</tr>
<tr>
<td>4</td>
<td>49</td>
<td>5.00</td>
</tr>
<tr>
<td>5</td>
<td>44</td>
<td>4.49</td>
</tr>
<tr>
<td>6</td>
<td>41</td>
<td>4.18</td>
</tr>
<tr>
<td>7</td>
<td>38</td>
<td>3.88</td>
</tr>
<tr>
<td>8</td>
<td>36</td>
<td>3.67</td>
</tr>
<tr>
<td>9</td>
<td>34</td>
<td>3.47</td>
</tr>
<tr>
<td>10</td>
<td>32</td>
<td>3.26</td>
</tr>
</tbody>
</table>

\[ h(F) = 92F^{-0.456} \] (Douglas and Miller, 1974)
between flights (I). Douglas and Miller comment that their model may overestimate stochastic delay when the load factor is high.

Inclusion of the average interval between flights in the expression for stochastic delay implies that \( F \) will have a direct effect on delay through its influence on \( I \). Hence the Douglas and Miller delay function will not be homogeneous of degree zero. Even though this condition is not met the Douglas and Miller estimates indicate the effect of changing frequency is not likely to be significant.

Table 4.2 includes estimates of the direct effect of changes in frequency on stochastic delay and generally the value of the change is small. These data suggest that, for these daily frequencies, the conditions for a zero profit optimum could hold approximately.
TABLE 4.2: Estimates of the Effects of Change in Frequency on Average Stochastic Delay

<table>
<thead>
<tr>
<th>Passengers per flight (Q)a</th>
<th>F</th>
<th>Change in Stochastic Delay for a marginal change in F</th>
<th>Value ($) ($6.12/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Load Factor]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>162 [60 per cent]</td>
<td>2</td>
<td>-14.4</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-4.3</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>-2.2</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>-1.2</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>-0.8</td>
<td>0.08</td>
</tr>
<tr>
<td>243 [90 per cent]</td>
<td>2</td>
<td>-216.0</td>
<td>22.03</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>-64.8</td>
<td>6.61</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>-32.4</td>
<td>3.30</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>-18.0</td>
<td>1.84</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>-11.7</td>
<td>1.19</td>
</tr>
</tbody>
</table>

Notes:

a Average seating capacity per flight was assumed to be 270, approximately equal to average capacity on the Australia-NZ route. Passengers per flight were calculated using load factors expected to be at the extremes of current load factors on international routes.

b Stochastic delay per passenger per day is calculated from the Douglas and Miller (1974) formula

\[
g = 0.455 \left[ \frac{Q}{\sigma} \right]^{-0.645} \cdot \left[ \frac{(m - Q)}{\sigma} \right]^{-1.79} \cdot I
\]

where \( I = 1440/F \)

\( \sigma = 4.12Q^{1/2} \)

\( m = 270 \)

The figures in the third column are the change in \( g \) for a unit change in \( F \) with \( Q \), hence \( \sigma \), constant, which corresponds to the direct effect of a change in frequency on stochastic delay.
CHAPTER 5: RENT SEEKING

5.1. INTRODUCTION

The principle of each country's sovereignty over its airspace is now well established (see Chapter 2). As a result countries have monopoly power over landing rights in their territory. This power offers the opportunity to extract rents from consumers and a mechanism for doing so is the type of regulation observed in international civil aviation markets. This chapter contains discussion of rent seeking motives for regulation.

Two types of models of motives for rent seeking are presented. The first is the model common in the literature on the economics of regulation. It is called the 'private interest model' (see Stigler (1975) and Peltzman (1976)). In this model the regulators are assumed to act as if they maximise a utility function, which has as arguments the surpluses of consumers and producers. However these surpluses are not equally weighted. Producers have a higher weight because their demands for policies which increase producers' surpluses are more effective. The reason is that, in comparison, consumers are a fragmented group for each of whom the regulation, which reduces their surplus, imposes relatively small loss. Hence individual consumers have little to gain by organising a counter-lobby and the costs of doing so are relatively high. The producer lobby does not have these characteristics and so is relatively more powerful.

The second type of model is derived from literature on welfare gains from taxing foreigners (including the optimal tariff literature and papers by Peston, Katz and Gravelle (1976) and
Auquier and Caves (1979)). Normally monopoly pricing creates a deadweight loss but, in the case of international civil aviation, not all consumers may count because they are foreigners. This parochial view can be shown to make it profitable to unilaterally regulate, or monopolise, a route and charge a positive mark-up on the competitive price, even in the absence of a private interest motive for regulation. In other words, it could still pay to regulate even when consumer and producer surpluses are equally weighted. This second model is called here 'public interest'.

These models are applied to a number of questions in this chapter. One of them is whether the models predict regulation will be observed. Another is whether the models can explain the pervasiveness and persistence of regulation (evident in the description in Chapter 2).

The results of the discussion are also used to evaluate another argument often made in favour of regulation. This is the view that unilateral action is impossible, or, in other words, that deregulation would leave Australian international air transport consumers at the mercy of other countries. This view has been put by writers on aviation policy (see Forsyth (1981b, p.14) and Taneja (1980, Ch.3)) and by politicians; an example of the latter is the following statement by the Australian Minister of Transport:

1 Normally the title 'public interest' is reserved in the literature on the economics of regulation for motives for intervention which emphasise monopoly behaviour in its absence or the presence of externalities (see Chapter 6). The term 'public interest' is applied in this chapter, in the absence of these features, because it is assumed (local) consumer and producer interests have equal weight; the model in this case is a theory of public interest rent seeking.
"it must be remembered that the aviation industry is one which is heavily controlled by governments - all governments. So to speak of open competition in such an environment pays no regard to the international situation. Other governments will not embrace open skies policies, and, given that, for Australia to declare such a policy would simply be to hand over aviation policy to other governments, allowing them to make decisions for us on such areas as scheduling and pricing." (Hansard, HR, 6 March 1979, p.619)

A third application of the results is to derive a more detailed characterisation of the current regulatory regime. For example, at the end of Chapter 2 it was concluded that the features of regulation are control of entry, capacity and, until recently, fares. But more specific description is required. For example, one question is by what rule will fares be set? A simple model would be that fares are set to ensure the survival of the higher cost operator on a route. But it is not clear why the home country of the other carrier (assuming a pure third and fourth freedom regime) would submit to such a rule. Given its monopoly power, that country can bargain for another rule which will impose smaller loss on its consumers. The question is what will be the solution of this bargaining? This more detailed characterisation of regulation is applied in calculation of its cost (Chapter 9) and discussion of policy options (Chapter 10).

The plan of this chapter is that the next section describes the model used, which can incorporate both the private and public interest rent seeking motives. The subsequent section shows that unilateral regulation always pays. Then the gains from retaliation are discussed. Finally, there is discussion of some solutions to the bargaining that follows retaliation. The results are then applied to the questions raised in this introduction.
5.2 THE MODEL

In this model, decisions on fares and flight frequency on a route are made by regulators. They act as if to maximise a utility function which is represented here as a weighted sum of consumer and producer surpluses (other sectors of the economy are ignored):

\[ U = aS + bR \]

where \( U \) is regulators' utility, \( S \) is consumer surplus and \( R \) is producer surplus. More generally this function could be written \( U = U(S, R) \) (as in Peltzman (1976)) so the weights \((a \text{ and } b)\) can be interpreted as marginal utilities which here are held constant.\(^1\) Initially \( S \) and \( R \) are restricted to the surpluses of domestic (or country \( H \)) consumers and producers and the model is applied to a single route. Results for the public interest model are obtained by setting \( a=b \) and, for the private interest model, by assuming \( a<b \).

Consumer surplus is defined consistently with the model of air transport demand used in Chapters 3 and 4. It is the area under the full price demand curve,\(^2\) above the current full price:

\[ S = \int_{P*}^{P} D^H(P*)dP* \]

where \( P* = P + d \), the sum of the money fare \( (P) \) and the cost of delay \( (d) \). In this model all consumers have identical evaluations of delay and the delay function \( (d = d(T,F), \text{ where } T \text{ is total passenger trips and } F \text{ is flight frequency}) \) is homogeneous of degree zero in its arguments.

\(^1\) Another implication of constant marginal utilities is that the regulators are risk neutral.

\(^2\) The distinction between actual and compensated demand curves is ignored here.
Producer surplus is defined as

$$R = c(PT - F_k H) = cI^H$$

where $c$ is the share of the country $H$ carrier in frequency and revenue and $I^H$ is the term in brackets. Cost per flight is assumed a constant amount, $k$, but $k$ can vary between countries (hence the $H$ superscript).

The regulators problem is to choose prices and total frequency to maximise $U$. At this stage, one strategy is excluded. Since the regulators are trading off producer rents against loss of consumer surplus, the best policy (in either model) would be to price discriminate between foreigners and local consumers. This option is assumed to be impossible.

Auquier and Caves (1979) justify their concentration on the policy of monopolisation, in place of taxes on foreigners, on the grounds that the former is less obtrusive and less likely to lead to retaliation (not modelled by them). This justification could not be applied to international civil aviation where the exclusion of a foreign carrier is obvious, a point emphasised below. A stronger ground for presuming discrimination is not possible would be that arbitrage cannot be avoided. This may not be the case in aviation where consumption of the service is closely monitored by the airline. For example, if tickets in the local market are bought by both local residents and foreigners, the latter could be distinguished by their passports. (The system could operate like the current administration of student discount ticket sales on Australian domestic routes). Alternatively, if tickets bought in the local market were bought only by local residents, the discrimination system could be simply based on the point of
purchase. The assumption of no discrimination, therefore, does not appear a plausible one. However, a model which retains the assumption is still relevant. The reason is that the introduction of unilateral price discrimination against foreigners would be expected to lead to retaliation and negotiation of fares. In that case, the model of the next section is still relevant. In summary, the assumption of no price discrimination is retained, despite its implausibility, because of the simplification it adds without the loss of the essential features of gains from unilateral action and retaliation.

5.3 UNILATERAL REGULATION

The price and frequency chosen under unilateral regulation are discussed in this section. The first order conditions for optimal frequency and toll are respectively

\[ U_F = aS_F + bR_F = 0 \]
\[ U_P = aS_P + bR_P = 0 \]

The optimal toll condition can be solved for the money fare \( P \):

\[ P = Td_T/[1+(1/e)(1-aH/bcT)] \]

Another expression of interest is the mark-up on the competitive fare. In Chapter 3, the competitive fare was shown to be \( Td_T \) so the optimal mark-up \( (M) \) is:

---

1 Relevant partial derivatives are:

\[ Sp = -D^H(P^*), \frac{\partial P^*}{\partial P} = -D^H(T + dT/dP) \]
\[ SF = -D^H(P^*), \frac{\partial P^*}{\partial F} = -D^H(dT/dF) + dF \]
\[ Rp = c(T + P \ dT/dP) \]
\[ RF = c(P(dT/dF)-kH) \]

Second order conditions are assumed satisfied.
\[ M = \frac{(P - T_d)}{P} = -\frac{1}{e}(1 - \frac{a_b^H}{bcT}) \]

where \( e \) is the money price elasticity of demand.\(^1\)

The condition for optimal frequency can be manipulated and simplified, using the optimal toll condition, to

\[ k^H = -cT_d \]

The results of this model of unilateral regulation can be illustrated by considering some special cases. These cases are listed in Table 5.1. The cases are defined by the values of parameters \( a, b, \) and \( c \). In most cases \( c \) is assumed to be unity which simply means that country \( H \) has unilaterally regulated; the more general case was presented here for later application. Each case is associated with a brief description, such as 'general' for the general conditions in the first row of the table.

It is simplest to first consider the optimal frequency conditions. When \( c=1 \), so country \( H \) provides all the flights, the optimal frequency conditions appear to be the same in all cases, and the same as the optimal frequency condition derived in Chapter 3. But it should be noted that while the conditions look the same, frequency will not be the same because \( T \) is varying. \( T \) is varying because the full price of travel is changing, as indicated by the varying mark-ups in the second column. The next step is to describe the characteristics of the optimal mark-ups in the special cases listed in Table 5.1.

(a) Public interest

In this case, producer and consumer surpluses are equally weighted and the motive for intervention is to extract surplus from

\[ 1 \quad e = \left( \frac{\partial T}{\partial P} \right)_d \cdot \frac{P}{T} < 0 \]
### TABLE 5.1: Unilateral Regulation by Country H

<table>
<thead>
<tr>
<th>Case</th>
<th>Optimal Frequency</th>
<th>Optimal Mark-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a&lt;b$, $c&lt;1$ (General)</td>
<td>$-cT_dF = k^H$</td>
<td>$-(1/e)[1-ab^H/bcT]$</td>
</tr>
<tr>
<td>$a=b$, $c=1$ (Public Interest)</td>
<td>$-T_dF = k^H$</td>
<td>$-(1/e)(1-D^H/T)-(1/e)(D^O/T)$</td>
</tr>
<tr>
<td>$a&lt;b$, $c=1$ (Private Interest)</td>
<td>$-T_dF = k^H$</td>
<td>$-(1/e)[1-(a/b)(D^H/T)]$</td>
</tr>
<tr>
<td>$a=0$, $b=1$, $c=1$ (Profit Max.)</td>
<td>$-T_dF = k^H$</td>
<td>$-\frac{1}{e}$</td>
</tr>
<tr>
<td>$a=b$, $c=1$, $D^H = T$  (Welfare Max.)</td>
<td>$-T_dF = k^H$</td>
<td>0</td>
</tr>
</tbody>
</table>


foreigners which more than offsets the loss of surplus by domestic consumers. This motive is reflected in the optimal mark-up which is the product of the inverse of the price elasticity of demand and the proportion of trips by foreigners in total passenger trips. In other words, the mark-up will be higher the less important are local consumers in the market. This is the result of Peston, Katz and Gravelle (1976) and Auquier and Caves (1979).

(b) Private interest

In this case producer interests weigh more heavily in the regulators' utility function than consumer interests. The mark-up in this case will be positive, and higher than in the public interest case, since $a/b$ and $D^H/T$ are both less than one.

(c) Profit maximisation

When consumer interests carry no weight at all, the optimality conditions correspond to the rules that a profit maximising firm would use. The same market results were derived in Chapter 3 (an optimal mark-up of $-1/e$ means the money fare is $P = Td_T/(1+(1/e))$). The case shown here is the monopoly pricing result.

(d) Welfare maximisation

In this case, consumer and producer interests are equally weighted and $D^H$ is replaced by $T$ so all surpluses count. Then the optimal mark-up is zero so the optimal toll is $Td_T$. This is the welfare maximisation result derived in Chapter 3. One qualification is that the optimal frequency condition is based on the costs of the
carrier of the country H and if these costs are not the lowest available, frequency will be too low.

A question to which this model can be applied is whether unilateral regulation pays? An equivalent question is whether the optimal mark-up is not zero? This is true in all special cases listed in Table 5.1 as long as the surpluses of only domestic consumers count. That is, even when consumer and producer interests are equally weighted, regulation pays when a parochial view is taken.

An important characteristic of the model should be noted at this stage. It is that the mark-up, when positive, varies inversely with the elasticity of demand (e). This elasticity will be high on routes for which there are close substitutes which typically means routes in close proximity. In these cases, unilateral regulation will still pay, though the mark-up will be less in both private and public interest models than when the elasticity is lower.

Before considering the retaliatory response of the country at the other end of the route, a perspective of the model can be obtained by examining the effects of relaxing briefly two of its assumptions. First, the assumption that price discrimination is impossible is relaxed. Country H would still want to monopolise the route but now the market would be segmented. In the private interest model, fares to both foreigners and residents would contain a positive mark-up, the size of which would be inversely related to the (absolute value of the) group's elasticity of demand. In the public interest model, the residents' mark-up would be zero while foreigners would be taxed.

Another assumption is relaxed by incorporating other sectors of the economy into the model. An obvious choice is the
group of producers of tourist services (like hotels or domestic travel). The interests of this group would be toward taxing residents (to encourage them to take holidays at home) and subsidising foreigners. To the extent this group has some weight in the regulators' utility function, their views will lead to a lower mark-up on foreigners' fares. In the extreme case where only their views count, the pricing policy, under unilateral action, will be reversed. However, the important point is that unilateral action still pays.

Discussion of the implications of relaxing these assumptions emphasises the point made earlier that the model of unilateral action represents a simplified view of the motives and opportunities of regulators but it retains the essential features of the gains from unilateral action and, as discussed in the next section, the incentive to retaliate.

Finally, it is interesting to use this model of unilateral action to speculate about the source of the pressure for the ICAP Report and the subsequent change in the fare structure. The context of the Report (discussed in Chapter 2) suggests that the Laker entry bid raised consumer expectations that fares could be lower and so effectively raised the weight on consumer interests in the regulators' utility function. The change in the fare structure proposed by Australia could be explained by dividing consumers into groups and raising the weight on the group with preferences for advance purchase excursion tickets, that part of the market to which the Laker proposals probably had most appeal. A different variation on the model suggests another explanation of these events. If local tourist interests were added to the regulators' utility function with a positive weight, there would be pressure toward lower fares
to increase the volume of foreign tourists. This effect of lower fares was emphasised by Laker in submissions to an Australian inquiry.¹

5.4 RETALIATION

So far the discussion has concentrated on the decisions of one country which was able to set price and frequency because it had monopolised a route. Other airlines were excluded, including those of the country at the other end of the route. The next step is to consider how that country might react. By its power over landing rights, the country at the other end of the route can react by enforcing its rights and demanding a share of the monopoly rents being earned on the route. It is argued in this section that this type of retaliation always pays. More specifically, it is argued that retaliation in kind always pays. The reason is that such retaliation creates the context for further gains, to the retaliator, through cooperative bargaining. This type of bargaining, over fares and frequencies, characterises the current regime.

The method used in this section is to derive each country's indifference curves then use a diagram like the Edgeworth box to discuss retaliation. The assumption that c (the share of country H in total profits) is unity is now relaxed.²

¹ Laker Airways Ltd. submission to the House of Representatives Select Committee on Tourism, Official Hansard Report, 23 May 1977, Canberra.

² Throughout this section, it is assumed that costs per flight are constant and equal in both countries. This means c can be interpreted as the share of total profits earned on the route.
The characteristics of the indifference curves of country H are illustrated in Figure 5.1. This diagram shows contours of combinations of c and M between which the country is indifferent, while F is held constant. Some features of the indifference curves are worth discussing.

The first feature is that when profits are positive, the curves have a shape like that of $U_2$. At a low mark-up, profits increase with the mark-up and more than offset the loss of consumer surplus ($U_H^P > 0$). In that case, utility is held constant by taking a lower share (c) of profit. After the optimal money price has been reached, the reverse applies and the slope of the indifference curves becomes positive.

In the diagram, it is assumed that mark-ups below zero yield negative profits. In that case, the shape of the indifference curves is reversed, for example, like $U_1$. Along $U_1$, higher P raises profits (reduces losses) and also lowers consumer surplus. But at a low M, the former effect offsets the latter so c must be raised to maintain utility at the same level. Once the optimum M is reached, the slope of the indifference curves becomes negative. An

\[ U^H = aS^H + bR^H \]
\[ \frac{dP}{dc} \bigg|_{U^H=U^H} = -U^H/U^H \]
\[ U^H_c = b1^H \]
\[ U^H = b1^H \]
\[ \frac{dP}{dc} \bigg|_{U^H=U^H} = -b1^H/U^H \]

The indifference curves in Figure 5.1 are actually drawn depending on the mark-up.
Figure 5.1 Country H Indifference Curves
intuitive explanation of why a country would prefer a negative mark-up, given shares like $c^*_1$ is presented below. When profits are negative, utility is raised by lowering $c$ given $M$; the reverse applies when profits are positive.

The line $HH$ is the locus of optimal mark-ups, given the shares. This line is defined by

$$M = -(1/e) \left[ 1 - \frac{a^H b^H}{b^H c^H} \right]$$

which is the optimal mark-up expression derived earlier. The slope of $HH$ is positive but decreasing. Using the expression for $HH$, it is possible to define the characteristics of the point $c_3$, where optimum $M$ is zero, and then offer an explanation of why a country would prefer a negative mark-up.

Optimum $M$ will be zero when the term in brackets is zero which occurs when

$$c = \frac{a^H b^H}{b^H c^H}$$

Then take the case where $a^H = b^H$ so the critical profit share is $D^H/T$, the share of local consumers in total traffic. When the share in profits is less than $D^H/T$, country $H$ would prefer negative profits because it gains more by the addition to consumer surplus. (In the extreme, if $c=0$, country $H$ would prefer its consumers to get the service for free or, even better, be paid to consume it!)

As the mark-up approaches the zero profit level, the slope of the indifference curves becomes small (in absolute terms). As a result, the negatively sloped sections of the indifference curves become compact between the $HH$ locus and the zero profit line, here also the $c$-axis.
The set of indifference curves is dense. For example, to the right of $c_3$ and below the $c$-axis, there is a series of positively sloped indifference curves none of which reach an infinite slope before the zero profit point is reached. At zero profit, they become flat. Similarly, above the $c$-axis and to the left of $c_3$, there is another series of positively sloped curves.

The indifference curves for country $O$ can be combined on the same diagram as those for country $H$, since the share of country $O$ is $1-c$. The country $O$ set has its origin at $c=1$ and has the reverse shape to that of country $H$. Figure 5.2 shows the loci of optimum mark-ups from each set.¹

There are a number of points of interest in Figure 5.2. The characteristics of the points A and B have already been discussed; at these points, at a zero mark-up, the shares are equal to the product of the $a/b$ ratio and the proportion of local consumers in total trips. Another point of interest is $D$ where the loci intersect. At this point,

$$c = a^Hb^H/(a^00^O+a^Hb^H)$$

or, in the special case where $a^H = a^O$, the intersection occurs where $c = D^H/T$. Generally, this mark-up will coincide with a positive mark-up but when $a^H = a^O = b$, the loci must intersect at a zero mark-up (because of the characteristics of points like $A$ or $B$), illustrated in Figure 5.2 by raising the $c$-axis to $Z'$. The loci end-points are the mark-ups by each country under unilateral regulation.

¹ The utility functions are only preference orderings so nothing is lost by assuming $b^H = b^O$. This assumption is made from now on; country preferences are distinguished by the value of $a/b$. 
Figure 5.2 Loci of Optimal Mark-Ups
A diagram like Figure 5.2 can be used to discuss the gains from retaliation. This diagram is Figure 5.3. For simplicity it is assumed that $a^H = a^O = b$, so the loci intersect at the zero mark-up. The end-points become

$$M = -(1/e)(D^O/T)$$

for country H and

$$M = -(1/e)(D^H/T)$$

for country $O$. These end-points are the optimal mark-ups under unilateral regulation in the public interest model. Finally, it is assumed that country $O$ was the first to regulate so the starting point is $A$ in Figure 5.3.

Country H has power over landing rights so its immediate response to monopolisation by country $O$ could be to withdraw (or threaten to withdraw) rights from the carrier of that country. Instead country H may demand a share of the rents earned by country $O$. The latter is likely to accede to this request because of the underlying threat of withdrawal of traffic rights. The share demanded by country H could be that corresponding to $B$ in Figure 5.3. This type of retaliation always pays since country H is better off at $B$ (or another point like it) than at $A$.

---

1 Even if the utility function is expanded to incorporate other sectors of the economy such as tourist industry interests, retaliation still pays. To illustrate just one of the many possible combinations, assume country H has a utility function in which only the interests of hoteliers count while country $O$ has a utility function where the interests of its consumers and airline producers are equally weighted. Assume country H initiates regulation by taxing travel of its residents. Country $O$ would be in favour of the direction of this pricing policy but it would have to retaliate to obtain a share of the rents.
Figure 5.3 Gains from Retaliation
This form of retaliation is not the only one possible. Another would be for country H to subsidise its consumers to offset the effects on consumer surplus of the mark-up imposed by country O. In this case, the loss imposed on country H would be replaced, and presumably reduced, by another, in a more broadly based tax system, due to the welfare costs of raising the subsidy revenue. The transfer from country H to country O would still occur except it would now be raised by another mechanism and its incidence in country H would be different.¹

The subsidy response is not likely. One reason is that retaliation by enforcing power over landing rights has the advantage of setting the stage for further bargaining over the size of the transfer. This motive for retaliation in kind has been noted in the optimal tariff literature (El-Agraa, 1979).

The advantages of retaliation in kind can be illustrated by noting that at A there is no scope for gains from bargaining over M and c in the feasible range \(0 \leq c \leq 1\). The reason is that the indifference curve of country O is tangential to the M axis at A. But if the starting point were shifted, to say B, there would be scope for gain.

To illustrate the gains from cooperative bargaining, take B in Figure 5.3 as the starting point then the final solution would lie on the contract curve in the lens defined by the intersection of the indifference curves at B. The location of the final solution depends on the shape on the contract curve and on bargaining powers.

¹ Even if the subsidy were adopted there would still be a loss from a world point of view since the transfer mechanism, via rents to the airline, imposes costs on consumers of country O which would be avoided if direct payments were made.
While the final solution to bargaining is not known (and neither is the opening demand by the retaliating country, such as point B), in the model specified so far, one point is certain. The ultimate threat is no trade and pay-offs of zero to both countries.

Discussion so far has relied on Figure 5.3 to illustrate the characteristics of the contract curve. The figure was restricted to the optimal mark-up and took frequency as given. Ideally, choice of frequency should be included in the bargaining and this can be done in a more formal treatment of the problem, reported in the next section.

5.5 COOPERATIVE BARGAINING

5.5.1 Introduction

In cooperation countries will act to maximise their joint utility,\(^1\) denoted here by \(L\), and equal to

\[
L = a^H S^H + a^O S^O + R^H + R^O
\]

Here, for simplicity, it is assumed that \(b=1\) so \(L\) is a welfare index defined in units of producer rents. The problem is for the negotiators to choose \(P\) and \(F\) to maximise \(L\). The solution only defines the set of Pareto optimal points. The negotiators then must choose between those points, in this model, by choosing \(c\). It is

---

1 This approach is equivalent to maximising the utility of one country (say \(H\)) subject to utility levels of the other. In this case the Lagrangean \((L)\) would be \(L = U^H + fU^O\) where \(f\) is a Lagrangean multiplier. Another interpretation of \(f\) is that it is the shadow price of a unit of \(U^O\) in terms of \(U^H\). But in this problem, both utilities are expressed in dollar terms and so \(f\) can be taken equal to one. See Bacharach (1976, p.107) for use of this method in another monopoly problem.
helpful to present the solutions to the first stage of this problem by considering some special cases.

5.5.2 Equal costs per flight

In this case $k^H = k^O$ so the sum of producer rents in each country is total profits. The first order conditions for optimal $P$ and $F$ are

$$L_P = a^H_S P^H + a^O_S P^O + P\frac{dT}{dP} = 0$$

$$L_F = a^H_S F^H + a^O_S F^O + P\frac{dT}{dF} - k = 0$$

From the condition $L_P = 0$ the optimal price is

$$P = \frac{Td_T}{[1 + (1/e) - (a^H_D + a^O_D)/T]}$$

so the optimal mark-up can be written

$$M = -(1/e) \frac{[1 - (a^H_D + a^O_D)/T]}$$

The optimal frequency condition is

$$k = -Td_F$$

Some special cases of these results, defined by the values of $a$, are listed in Table 5.2. Some of the results could have been predicted from the specification of $L$. For example, if $a$ is one in both countries, $L$ is equal to the sum of surpluses so the result must correspond to welfare maximisation. If $a$ is zero in both countries, they act as a profit maximising cartel.

---

1 The model could also have been specified by assuming unequal but non-constant costs per flight of the form $k^H(F^H)$ and $k^O(F^O)$. Then the decision variables would have been $P$, total frequency and the share of frequency by country (not necessarily equal to their profit shares). In the total frequency condition, $k$ would then have replaced by the marginal cost of an extra flight, which would have been equalised in the two countries by sharing $F$. (Average costs per flight would have to be rising for both countries to provide flights.)
There are differences between the mark-ups that emerge from cooperative bargaining and those set under unilateral regulation, even when the utility functions have the same characteristics in both cases. For example, in Table 5.2 in the public interest case, the optimal mark-up is now always zero. Under unilateral regulation, it was always positive. In the private interest model the mark-up is now less than under unilateral regulation, because the loading given to foreigners has disappeared. On the other hand, in the case of profit maximisation, the mark-up is the same; the two countries act as a profit maximising cartel but now the rents must be shared.

A couple of results are worth emphasising. The first is that when the regulators have identical relative weights in their utility functions, the mark-up will be positive in the cooperative solution as long as there is an element of private interest, that is, \( a < b \). Simply a parochial view is no longer sufficient to generate a positive \( M \). Cooperative bargaining tempers the mark-up when \( a \) is still positive but less than \( b \), in comparison to the unilateral action case. The variation in mark-ups suggests a test of the motive for regulation which is discussed in section 5.7.

5.5.3 Unequal costs per flight

5.5.3.1 Profit sharing

Presuming profit sharing is possible and costs per flight are constant but unequal, all flights would be provided by the lower cost operator. The optimal mark-up and frequency would be determined by the conditions in Table 5.2 and any profits would be divided by the shares \( c \) and \( 1-c \).
TABLE 5.2: Cooperative Bargaining (Equal Costs per flight) (b=1)

<table>
<thead>
<tr>
<th>Case Name</th>
<th>$a_0$, $a^H$</th>
<th>Optimal Frequency</th>
<th>Optimal Mark-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>$a_0=a^H$</td>
<td>$-T_dF=k$</td>
<td>$-(1/e)[1-(a^H+1)/T]$</td>
</tr>
<tr>
<td>Public interest</td>
<td>$a_0=a^H=1$</td>
<td>$-T_dF=k$</td>
<td>0</td>
</tr>
<tr>
<td>Private Interest</td>
<td>$a_0=a^H=1$</td>
<td>$-T_dF=k$</td>
<td>$-(1/e)[1-a]$</td>
</tr>
<tr>
<td>Profit Max.</td>
<td>$a_0=a^H=0$</td>
<td>$-T_dF=k$</td>
<td>$-1/e$</td>
</tr>
<tr>
<td>Welfare Max.</td>
<td></td>
<td></td>
<td>[see Public Interest case]</td>
</tr>
</tbody>
</table>
Mechanisms for profit sharing (commercial agreements) are observed in international civil aviation (see Chapter 2). The Pareto improvements they make possible when costs per flight are not equal are clear. But an implication of the profit sharing, with constant unit costs, model is that only the low cost operators would survive. This is not so. Operators with a wide range of operating costs are observed (see Chapter 8 for evidence). This suggests examination of the case where profit sharing is not possible, an approximation to the actual case of limited use of sharing profits, is worthwhile.

There are two possible explanations of why profit sharing is not extensive, maintaining the assumption of constant costs per flight. In terms of the private interest model, the regulators may not be able to make the transfers to factor owners in a direct way and so need an airline based in their country to survive. In terms of the public interest model, an explanation might be that, at least in the eyes of the regulators, the airline generates an externality (a view which need not be justified as argued in Chapter 6) and so should survive; regulators are unwilling to pay direct subsidies because, anticipating discussion below, they fear unilateral

1 Survival of a number of operators is consistent with a model when cost functions are not identical but where marginal cost is rising. Econometric evidence reviewed below suggests constant, even declining, marginal costs of frequency.

2 A draft pooling agreement is published in annex 04 of the ICAP Report (ICAP, 1978). The draft shows that pool settlements are limited to an agreed percentage of the total pool and that capacity inequality should be overcome by airline management. These features suggest that pooling is used only for fine tuning to capacity agreements, and not as a mechanism for allowing the low cost operator to provide all the capacity.
regulation by other countries if a policy of 'open skies' with subsidies were declared.

5.5.3.2 No profit sharing

In previous cases, the shares of rents could be independent of shares of frequency. When there is no pooling (approximating the case of restricted use of pooling because of the imposition of other constraints discussed in the previous sub-section), shares of frequency and revenue must correspond. In that case, joint utility is written

\[ L' = aH^H + aS^O + PT - cFk - (1-c)Fk^0 \]

The optimal price and mark-up remain the same in all models but now the optimal frequency condition becomes

\[ (ck^H + (1-c)k^0) = -Td_F \]

The next step is to consider how the shares (c and (1-c)) are determined in this and the previous case of profit sharing.

5.6 DETERMINATION OF SHARES

5.6.1 Introduction

There are two cases to consider in this section. In the first, sharing of profit is possible. Hence if costs per flight (assumed throughout to be constant) are not equal the low cost carrier will provide all capacity. In the other case, profit sharing is not possible. In the first case, the shares (c and (1-c)) refer to shares in total profits available. In the second case, they refer to shares of both revenue and flight frequency.
5.6.2 Profit sharing

The set of Pareto optimal points is illustrated in Figure 5.4. It is assumed here that only profits on airline operations can be shared. The implication is that if point G defines the consumer surpluses arrived at after imposition of the optimal mark-up (here independent of shares) and flight frequency the problem is to share the rents, indicated by the length of BG (equal to AG). If further transfers were possible, the set of points open to the negotiators would not be restricted to AB but would extend to the axes.

One solution to the problem is that of Nash.\(^1\) The first step in deriving the Nash solution is to specify a point called the status quo. This is the point to which both players return when no agreement is reached. This point corresponds to 'no trade', that is, utilities of zero for both countries.\(^2\) The Nash solution divides profits so the product of the increments to utility over the status quo is maximised. Since zero utility for both countries is the status quo, this rule means maximising the product of \(U^H\) and \(U^0\). The result is that when costs per flight are equal in both countries, profits must be allocated to equalise utilities.\(^3\)

---

1 See Bacharach (1976, ch.5) for description of the Nash solution which satisfies the four axioms of Pareto optimality, non-comparability of utilities, symmetry and independence of irrelevant alternatives. The Nash solution described here is that of a 'bargaining game'. Each country is assumed to know the preferences of the other.

2 In a more complicated game each player could have a range of threats (Bacharach, 1976, ch.5) but attention is restricted here to the simpler game.

3 The condition is

\[ U^H_c + U^0_c = 0 \]
Figure 5.4 Sharing Rules
This allocation is shown as point D in Figure 5.4. The implication is that profits are shared to offset differences in consumer surplus; the country with the smaller number of travellers will tend to receive the larger share of the profits. If $S^H = S^0$, and the values of $a$ are equal, then profits will be shared equally.

Some of the implications of the Nash solution may seem implausible. It is not, however, the only rule which could be used to determine shares of profit. Another plausible rule is that shares are predetermined by 'rights' to the profits earned on sales of tickets to local consumers. In this case, $c = D^H/T$ so the solution under this rule will lie at point E in Figure 5.4 (when values of $a$ are equal and consumers in both countries identical). Coincidence of this rule and the Nash solution will be a special case.

One feature of rule of 'rights' that adds support to its use is that when the two countries have identical utility functions, the loci of the optimal mark-ups intersect where $c = D^H/T$. An implication is that if shares are fixed at these values, the two

\[ U^H_c = PT-Fk^H = I^H_c \]

\[ U^0_c = -(PT-Fk^0) = -I^0_c \]

so the rule is

\[ U^0/U^H - U^0/U^H_c = I^0/I^H_c \]

but since $I^H = I^0$ in this case, $U^0 = U^H$. Flight frequency (F) is here independent of $c$. This is the usual result when utilities are specified to be linear functions of money (see Bacharach (1976, pp.101-2) for another example).

1 It could be $D$ lies at the end points of $AB$. 

3 (cont) $U^H_c = PT-Fk^H = I^H_c$ 

$U^0_c = -(PT-Fk^0) = -I^0_c$ 

so the rule is 

$U^0/U^H - U^0/U^H_c = I^0/I^H_c$ 

but since $I^H = I^0$ in this case, $U^0 = U^H$. Flight frequency (F) is here independent of $c$. This is the usual result when utilities are specified to be linear functions of money (see Bacharach (1976, pp.101-2) for another example).
countries will automatically agree on the same mark-up. Hence use of this rule could reduce bargaining costs.¹

5.6.3 No profit sharing

In this case (when costs per flight are not equal) the shares c and (1-c) determine both shares of revenue and frequency. The high cost country may earn negative profits in this case.² The Nash solution could be applied to determine the shares but there are two problems. First, the solution is difficult to illustrate diagrammatically, since a change in c changes frequency and hence changes consumer surplus as well as profits. Second, the possibility of negative profits means that the Nash solution could be at a corner, where one country provides all the flights; but this result conflicts with premise used to justify consideration of

¹ The costs of bargaining can be substantial; see Forsyth (1980) for an example of delays in bilateral talks on new fares between Australia and Japan. Forsyth notes (p.15) some sources of differences of opinion over fares to charge. He says Japan wanted higher fares from Japan (for balance of payments reasons) than from Australia while Australia wanted the same fares from both countries. Presuming tickets sold in the local market are bought mainly by local residents, the Japanese attitude implies a tax on residents. This view is not captured by the model used here but as pointed out earlier, the model is a simplification designed to identify the main factors explaining the pervasiveness and persistence of regulation.

² Assume a₀ = a^H = 1 and that country H is the higher cost country. Then its revenue is cTTd₁. In this model, it is assumed that Td₁ + Fd₁ = 0 (that is, the degree of homogeneity of the delay function is zero). This means revenue can also be written c[-Fd₁]. The costs of country H will be cFk^H so revenue will be less than costs if -Tdf<k^H. By the optimal frequency condition assumed to apply in the case of unequal costs, this condition holds (since k^H exceeds the average cost used to choose F) so country H earns negative profits. By the same method it can be shown country O earns a profit (which in this case equals the loss of country H).
this case. The latter difficulty does not arise when the shares are set equal to shares of local consumers in total traffic.\(^1\)

It is now possible to apply these results to the three questions listed in the Introduction to this Chapter.

5.7 APPLICATION OF RESULTS

5.7.1 Pervasiveness and persistence of regulation

Both the private and public interest models predict that unilateral regulation pays. It was also argued that retaliation in kind always pays. Hence regulation in both models will be pervasive. Both models also predict that regulation will be persistent but for different reasons.

In the private interest model, regulation is persistent because it continues to transfer rents to producers.\(^2\) The reason

---

1 Air transport has backhaul characteristics and so fares are negotiated in both directions on the same route at the same time. The backhaul characteristics suggest another way of dividing the total market which is to give each country a monopoly of traffic buying tickets in its local market. Each country would then only have to agree to admit each other's carrier. This solution is not observed. The difficulty in this type of policy is, from the regulators' point of view, that countries tend to be concerned with the fares available to incoming travellers. Also if fares diverge according to the point of sale there may be scope to undermine the goals of the high fare country by buying more tickets in the other country, for example, on a return trip, by buying two one-way tickets.

2 The relevant producers need not be owners of capital so rents could still be earned when profits are negative. Concentration on other input supplies need not be a qualification to the earlier assumption that negative profits are a 'bad' since profits can then be reinterpreted as the surplus available to the target group of input suppliers after paying normal returns to all other suppliers. A second qualification to this private interest explanation of persistence is the chance of losses. It was shown above that when costs per flight are not equal the high cost carrier would earn negative profit in the public interest model with a zero mark-up. The same result could occur in a private interest model, if the mark-up, though positive, was not high enough. In that case, the reason for persistence could that of the public interest model.
for persistence in the public interest model is more interesting. There are two cases to consider, the first where costs per flight are equal and the second where they are not. In the first case, the rules for optimal frequency and mark-up correspond to optimality. (see Table 5.2). Flights and revenue could be shared according to the proportion of trips by local consumers but since costs per flight are the same (and profits are zero) this rule is irrelevant. In summary, in the case of equal costs per flight and when $a = b$ in both countries, countries return to the welfare maximising position by cooperative bargaining and so are no worse or better off than in the absence of regulation.1

The second case is where costs per flight are not equal and both countries continue to provide capacity. The optimal mark-up in this case will still be zero. It has been shown that the total revenue raised equals the costs of all flights but that the high cost country makes negative profits. It will now be shown that both countries are worse off in comparison to the absence of regulation.

The first question is whether the low cost country is better off than in the absence of regulation. If so, it would mean the profit earned offsets the loss of consumer surplus. Consumers lose in this case, even though the mark-up is zero, because flights are chosen according to an average cost, higher than that used in competition so frequency will be restricted.

Profit on airline operations to country 0 is a fraction $(1-c)$ of $F(-T_{d_F} - k^0)$, where $T_{d_F}$ is determined by the optimal

---

1 A qualification to this result is that costs per flight, although equal for both countries, may not be the lowest available. The result in the text also applies when costs per flight are not equal but pooling is possible so all flights are provided by the lowest cost operator.
frequency condition. In Figure 5.5, the distance $oe$ is equal to $-Td_F$ so the area $aebc$ is equal to $F(-Td_F - k^0)$ and country 0 profit is $(1-c)$ of this area. But competitive frequency is equal to $F_C$ so by the restriction of frequency consumers have lost $aedc$ and country 0 consumers have lost a fraction $(1-c)$ of this area, since in this case $c = \frac{OH}{jT}$. Hence profits earned by country 0 will not offset the loss of consumer surplus and country 0 will lose overall from extensive regulation. Similarly country H consumers lose but also country H's airline makes a loss.

In summary, both countries are either worse off (when costs per flight are unequal) or no worse off (when costs per flight are equal or costs are unequal but profit sharing is possible) in the cooperative solution in comparison to the absence of intervention. The question is then why does regulation persist? The answer is mutual mistrust. Even though the final result is not better than free trade, both countries are generally better off than suffering unilateral regulation by the other country.¹

¹ This is equivalent to saying that retaliation always pays. There is however one case in which it may not pay to retaliate. To illustrate say costs per flight are unequal, there is no profit sharing and country H is the high cost carrier and country 0 has regulated. Then the gains from retaliation to country H are not clear. Country H would gain from the removal of the positive mark-up. But costs used to determine frequency are higher than the costs used by country 0 so country H will not get the full benefit of the removal of the positive mark-up. Country H's carrier earns a loss. Thus country H will lose from retaliation if the gain to its consumers are less than the negative profits earned by its airline. This is more likely when costs per flight by country H's carrier are very high. Another variable which could be important is the number of consumers in country H, but the net effect of this variable is uncertain. For example, if $DH/T$ [cont]
Figure 5.5 Optimal Frequency in Cooperative Bargaining with Unequal Costs Per Flight
5.7.2 Impossibility of unilateral action

The outcome in the case of the public interest model is like that of the Prisoners' Dilemma game, where pursuit of individual objectives leads to a result which is not socially preferred. The solution proposed to the Prisoners' dilemma game is communication. A similar form of cooperation would be valuable in the case of international civil aviation since it could remove the fear of being subject to the monopoly power of other countries. In other words, the fear that deregulation will leave a country at the mercy of others is real. It is also true that cooperation is required to avoid that result. Cooperation is a characteristic of the current regime but it is actually the result of non-cooperative behaviour. A different type of cooperation is required to achieve further welfare gains for both countries.

As an aside, a symbol of the cooperation which is claimed as a feature of the current regulatory regime is the fare setting mechanism of IATA (Taneja, 1980, ch.4). In some studies of the effects of international regulation, the IATA mechanism is also taken to be the source of the deadweight loss (Barnekov, 1978). The model of this chapter emphasises that it is the power of each government to control entry which is the ultimate source of any loss. This is evident in the description of recent trends in

1 is low then the mark-up to which consumers of country H are (cont) subjected under unilateral regulation by country 0 will be lower so there is a lower gain from moving to the zero mark-up. On the other hand, low DH/T means that c is low (under the 'rights' rule) so frequency by country H is low and the loss on airline operations will be less. If the high cost country did lose from the move from unilateral regulation to cooperative bargaining, it is expected it would opt for some other sharing rule, than the one assumed here, where it did gain from retaliation and the bargaining that followed.
Australian regulation which moved toward bilateral negotiation of fares (see Chapter 2). The IATA mechanism is only a tool for the regulators to solve the complicated problem of simultaneously setting fares on a number of routes which are substitutes and complements. The multilateral mechanism would be useful whichever motive for regulation was dominant.

5.7.3 Characterisation of regulation

This chapter has presented a number of models of regulation. They are distinguished by the motive for intervention, the cost levels of the carriers, the possibilities of sharing profit and the rules used to determine shares either of profits or of frequency and revenue.

The next step could be in one of two directions. It is possible to distinguish the private and public interest motives for intervention; the basic distinction, in terms of the model of this chapter, is the positive mark-up on the optimal toll in the former case. One path would then be to test which model is relevant. The other path is to take the existence of regulation as given then measure its effects and discuss policy options. In the absence of time constraints both paths could be explored but here, attention is restricted to the second course.

It is important in later chapters to have an explicit model of the regulatory process. For this purpose the public interest model is adopted. The main reason, which will become evident in Chapter 9, is that it is expected to lead to a lower bound estimate of the cost of regulation. The view is taken here that it is more informative to make statements of the type, the cost of regulation
is 'at least' some figure, rather than, the cost is 'at most' some figure. The form of the public interest model used is spelt out in Chapter 9, after the cost characteristics of regulated carriers have been examined.
6.1 INTRODUCTION

In this chapter, a miscellany of other motives for intervention are reviewed. The three motives discussed here as well as the service quality case and 'the impossibility of unilateral action' case, discussed in previous chapters, are the arguments commonly used to support regulation of international civil aviation.

6.2 MARKET STRUCTURE

The market structure argument for regulation corresponds to the natural monopoly argument, which was summarised by Demsetz (1968) as follows:

'If, because of production scale economies, it is less costly for one firm to produce a commodity in a given market than it is for two or more firms, then one firm will survive; if left unregulated, that firm will set price and output at monopoly levels; the price-output decision of that firm will be determined by profit maximising behavior constrained only by the market demand for the commodity.'  (Demsetz, 1968, p.56)

Subsequently, it could be argued, that the firm should be constrained by regulation. There is evidence of the use of this type of argument for regulation in debate and reports on civil aviation regulation. For example, Kirby (1981) cites examples of its use in Australian domestic civil aviation. It was reported in Chapter 2 that, in 1946, proponents of nationalisation appeared to
implicitly use a model in which air transport markets could become monopolised.\(^1\)

The method (suggested by Kirby (1981)) of evaluating the natural monopoly argument is to check whether its premise, the existence of scale economies, is justified in air transport and then, presuming scale economies are observed, to ask whether the prediction of the natural monopoly model will also be observed.

Scale economies could be observed at three levels, the first at the firm level, then at the network level and finally on individual routes. Reviewers (e.g. Bailey and Panzar (1981), Grenning and Coat (1979), White (1979)) of the literature on scale economies at the firm level typically report the consensus (since Caves (1962)) that there are no significant economies in firm size. Recently, evidence of scale economies has been reviewed by Caves, Christensen and Tretheway (1980). They agree that no scale economies would be observed at the firm level. But they argue this result reflects two offsetting influences. They observe scale economies in air transport output but their regression equations also include firm-specific dummy variables. The size of the coefficients on these dummies increases with firm size. The interpretation they give is that, within a network there are scale economies are not the only reason a market could become monopolised. Another is regulation; the ICAP Report (ICAP, 1978), after arguing the case for protection of scheduled carriers, also appeared to imply another role of regulation was to limit the monopoly power which pursuit of service quality objectives by intervention could generate. Power over landing rights discussed in Chapter 5, also led to monopoly power. Discussion in this Chapter concentrates on the case of falling unit cost of providing frequency.
economies but that as firm size increases, by expanding the network, there are offsetting diseconomies.¹

The third level to check for scale economies is the individual route. There are substantial scale economies in aircraft size (see Table 1 in Bailey and Panzar (1981)). The implication is that if passengers can be concentrated into fewer flights on a route, costs per passenger trip will be lower.² If there are also declining costs per flight, whatever the aircraft size, up to a few flights per day, the result is that on 'thin' routes, only one carrier will be observed. Such routes will be 'natural monopolies'.

In summary, it is possible that some routes will be served by one carrier. This monopoly may even extend, on the Caves, Christensen and Tretheway (1980) interpretation of their results, to a network. But because of constant returns at the firm level, all routes need not be served by one carrier.

The next question is whether it matters if routes, or networks, are served by one carrier? Since Demsetz' (1968) comment on the natural monopoly argument, it has been argued that the single

---

¹ Caves, Christensen and Tretheway try to test this hypothesis by including in their equations a measure of network size (route miles) but they conclude their measure does not provide an "adequate representation" of the effect of network size. Thus their interpretation remains a conjecture based on their firm-specific dummy variable results. White concluded that there are probably scale economies at the city-pair and local network level at low levels of output but they are not likely to be observed over all ranges of output (White, 1979, p.571).

² Cramming passengers into fewer flights could be constrained by passenger evaluation of frequency, emphasised in the model of Chapter 3. The cost saving from lower frequency could be traded off against the value of the loss of service quality; Forsyth (1981d) has used this observation to estimate the marginal value of frequency.
carrier will not behave monopolistically while there is no barrier
to the entry of new firms. There will be an entry barrier if there
is some cost of production which is borne by a firm seeking to enter
an industry but which is not borne by the incumbent (Stigler, 1968,
p.67). There is no reason why scale economies should constitute
such a barrier. What would constitute a barrier are sunk costs,
that is, costs that in a short or intermediate run cannot be
eliminated even by cessation of production. Such costs will
already have been incurred by the incumbent but not yet by the
entrant.

Are there sunk costs in air transport? The likely
candidates are the capital costs of the airlines, for example,
aircraft. But aircraft are not sunk because they are mobile between
markets and can be resold (Bailey, 1980, Bailey and Panzar, 1981).
There are other capital items which could be sunk. For example,
terminal facilities represent a sunk cost. But, as Bailey (1980)
argues, the barrier to entry they represent can be removed by having

---

1 The distinction between scale economies and sunk costs is
emphasised by Baumol and Willig (1981). Declining average
costs may be due to the presence of fixed costs, defined as
costs not changed by changes in output even in the long run
but eliminated in the long run by cessation of output. Sunk
costs cannot be avoided by cessation of production in the
short or intermediate run. Sunk costs may not be fixed and
fixed costs may not be sunk. As an example of the former type
of cost, Baumol and Willig suggest a car production line,
which is sunk in the shorter run but not fixed since its scale
can be reduced in the longer run if the scale of output is
reduced. A railroad track is an example of a cost which is
both sunk and fixed; even at very small, but positive,
output, the size of the track cost cannot be reduced in the
long run. Rolling stock or aircraft are examples of fixed
costs which are not sunk; if output is zero in the short run
they can be avoided but cannot be reduced in the long run
while output is still positive.
their costs borne in such a way that entrants are not faced with the risk of a large loss if their entry bid is not profitable.¹

In summary, airline firms are not characterised by large sunk costs. If methods of access to terminal facilities are carefully designed, airline markets need not be characterised by large sunk costs. Such markets can be described as contestable (Bailey and Panzar, 1981). The implication is their performance should match that of competition, even if there are scale economies.

The effect of contestability on pricing behaviour was examined by Bailey and Panzar (1981). The condition for contestability emphasised so far has been the absence of significant sunk costs and freedom of entry. But there are other conditions, implicitly taken for granted so far. These are (from Bailey (1980)) the existence of a pool of potential entrants and pricing flexibility. All these conditions were met in 1979 on long distance routes served by "local service" carriers in the US domestic market.² Bailey and Panzar found that on such routes, served by an apparent monopolist, the single carrier priced, more or less, at the competitive level. Bailey and Panzar concluded that the threat of entry can discipline a natural monopoly market.

1 Even if terminal facilities are publicly owned and leased to airlines, methods for allocating space, either in terminals or in time (landing slots) can still act as a barrier to entry if not carefully designed.

2 On other routes, those served by single trunk carriers, Bailey and Panzar could not test the contestability hypothesis because those carriers did not have pricing freedom. On short distance local service carrier routes, served by one carrier, competitive pricing was not observed. This result they argue was due to the lack of a pool of potential entrants with equipment suitable for such routes. This result need not imply such markets cannot be contestable since the lack of entrants could reflect the short run inelasticity of supply of aircraft, which Bailey and Panzar note (p.129).
The argument so far is that, while there may be scale economies in airline operations, air transport markets are contestable. Potential entry therefore disciplines apparent monopolists to behave competitively. However, when there are scale economies the competitive result need not be optimal.\(^1\) There are a number of responses to this point. First, there may be scale economies but, if after a few flights on a route, costs per flight become constant, then the result will be optimal; this is the model implicitly used in Chapter 3. Second, even if output is suboptimal, if regulation is appropriate it is of a different form to that observed in civil aviation markets. A subsidy could be appropriate, but entry and price control are not.\(^2\)

In conclusion, the natural monopoly argument is not a valid one in favour of the current regulation of international civil aviation.

6.3 DEFENCE AND OTHER EXTERNALITIES

The defence argument is that some goods yield a benefit of being available from local sources in war time, but that producers of the good cannot appropriate any part of this benefit so the good will be undersupplied. Intervention, which increases local output,

---

1. This point was emphasised by Telser (1969), commenting on Demsetz' (1968) argument.

2. Mechanisms for paying subsidies are discussed in Chapter 10. Another point is that the literature on sustainability of natural monopoly (Baumol and Willig, 1981) shows that when the conditions of the model apply (economies of scale and of multi-product output in contestable markets) the set of prices chosen will be Ramsey optimal, that is, they will maximise welfare subject to a zero profit constraint. However, it is still possible that a subsidy funded from a broadly based tax system could lead to a preferred result.
is therefore justified. This argument was prominent in debates on government assistance for civil aviation in the 'thirties and 'forties (see Chapter 2). Hocking and Haddon-Cave (1951, p.84) say:

"In its earliest phases Government policy in connection with civil aviation was dominated by the desire to strengthen the aerial defences of the country. It was thought that a vigorous industry would provide a nucleus of highly trained pilots and mechanics who could easily be absorbed into the air force should the outbreak of war necessitate the rapid expansion of that service. Civil aerodromes, landing grounds, hangars, and workshops would also be available for conversion to war-time purposes."

Similar arguments are still in use. The Minister for Transport said one of the benefits of the civil aviation policy of his government was that "the retention of Qantas as a viable and efficient operator provides essential defence capacity for times of peace and of national emergency". An ex-Chairman of Qantas, Sir Lenox Hewitt, asked rhetorically in an interview reported in The National Times on 10 November 1979 (p.38),

"... where do you think we'd be in the event of a disaster, be it a cyclone in Darwin, be it another outbreak of hostilities? Where do you think foreign airlines would fill that gap?"

The first steps in assessing the defence argument are to ask:

1. in what type of conflicts will the country be involved?
2. what notice will be given of these conflicts?

The relevance of the first question is illustrated by the observation that in a nuclear holocaust civil aviation will be

---

1 Hansard, HR, 6 March 1979, p.620. The ICAP Report contained a summary of a Defence Department submission (Section 16) and briefly referred to defence criteria but did not emphasise them nor comment on the Defence Department submission.
pathetically irrelevant. But strategic analysts have argued that it is feasible Australia could be involved in non-nuclear conflicts (O'Neill, 1976).

In the latter cases, what is the value of civil aviation? First civil aircraft could provide transport capacity for defence material and personnel. Second, civil aviation could provide a pool of skilled pilots and mechanics. Third, it could make available its maintenance facilities to defence forces.\(^1\)

Therefore, civil aviation could have some value as a defence input. Before concluding that intervention is justified, it must also be shown that, typically, insufficient notice of conflict will be available to allow foreign procurement of the inputs, such as aircraft, or to train pilots. Estimates of notice in O'Neill (1976) range from three to eighteen months which may be insufficient time to train Australian flying or maintenance personnel, but is long enough to obtain foreign aircraft.\(^2\) Hence there is likely to be a defence advantage in having readily available in Australia some civil aviation inputs but not necessarily aircraft.

The argument of the previous paragraphs suggest readily available civil aviation inputs could have some defence value. The case for intervention then requires this value is a genuine externality, that is, a value which cannot be appropriated by producers or owners of the inputs. This will be true where the

\(^1\) Other inputs with defence value are airfields and refuelling and material handling facilities, but since they are outside airline control they are also outside the topic of this section.

\(^2\) This period is too short if the defence category includes the availability of transport following natural disasters. The period of notice could be long enough to hire foreign pilots.
existence of a civil aviation sector acts as a deterrent to war. But during war prices of war inputs will rise and expectations in previous years of future profits will have encouraged producers to have available those goods expected to be in increased demand. In that case no public intervention would be necessary.

One reply to this view, that intervention is unnecessary to secure sufficient war related inputs, is Thompson's (1979) argument that the price rise will not occur because war is associated with price control.

Thompson's explanation of war time price control is that the existence of aggressors, who commit themselves to testing a nation's resolve to defend itself, leads to public defence choices necessarily being made by benevolent military dictators. The reason is that retaliation may appear irrational in the short run. But the value of the illusion of freedom to the dictator's subjects requires the dictator obtain resources not from direct but from indirect taxation via price control.

Another explanation of war time price control could be that it is a redistributive device, designed to avoid profiteering that would otherwise occur. But price control for this purpose will be costly; for example, it would inhibit the supply response the profits indicate is required. If redistribution were the goal, a cheaper option, such as profit taxes, is more likely to be used.

In order to be sympathetic to the defence argument, presume that, for some reason, war time price control is desirable. Then war time shortages will not be reflected in higher prices and, given lead time is required to ensure the availability of the valued war inputs, peace time intervention will be required. Effectively a
peace time subsidy to the production of the relevant goods is required.

Thompson discusses a number of mechanisms by which a subsidy can be effected. One is regulation of the aviation sector, where prices are set above competitive levels but capacity is not controlled. Competition in capacity, a valuable war time input, is permitted. This approach is characteristic of US domestic regulation (Douglas and Miller, 1974) but does not explain Australian regulation where both price and capacity are fixed.

Another comment on this argument for regulation is that regulation is not the only policy with the required result. For example, a direct subsidy can have the same result. For defence goals, a direct subsidy has the advantage of greater precision; for example, a subsidy could be paid only for aircraft which can quickly be converted to pure freighters. Other aspects of the comparison of regulation and its subsidy equivalent are discussed in Chapter 10.

In short, to justify intervention on defence grounds, it must be shown that

1. civil aviation can provide valuable inputs in conflicts expected
2. foreign procurement of these inputs is too slow
3. owners of inputs cannot appropriate the value of the defence advantages of their assets
4. regulation is the cheapest method of ensuring provision of precisely the right set of inputs.

Apart from defence gains, it is often asserted that international civil aviation generates other external effects. These effects were not emphasised in the ICAP report but have been used by other
commentators to justify intervention in civil aviation markets. These externalities include the value of the presence of the Australian flag in foreign countries, the prestige of having an international carrier and its use as an instrument of foreign policy.\textsuperscript{1} The editors of the \textit{Melbourne Age} (in an editorial of 17 November 1981, p.13) wrote "Qantas remains probably the best-known symbol of Australian excellence abroad ... Qantas is a national asset that must be preserved." In short, the argument is that a national flag carrier should be supported because there are external effects which only it can generate.

If it can be presumed these effects are genuine, the question is what is the cheapest way of achieving them? Regulation of international civil aviation, which recent experience (in the dispute with members of ASEAN) suggests has not generated positive foreign relations benefits, may not be the cheapest method (see Chapter 10). No comfort can be taken from the fact that there is already regulation. The reason is that there are other hypotheses about the existence of regulation which predict its aim is to redistribute income to particular groups of factor owners (Peltzman, 1976). For example, in comparison to the welfare criterion used here, these models would put higher weight on producer than on consumer interests and such a model would predict the current type

\textsuperscript{1} As an aside, an hypothesis about the foreign relations value of international civil aviation is that it occurs because of government involvement in negotiating the conditions for trade. In an ordinary commercial regime, aviation may be treated no differently than any other traded services. If so, this suggests the 'externality' could be removed by countries agreeing to treat aviation like any other good which is traded between their shores. This will require cooperation between countries and the need for cooperation to achieve a more efficient air transport system was discussed in Chapter 5.
of regulation, as noted in Chapter 5. The assumption of equal weights on producer and consumer interests, the welfare criterion used here, implies redistributive goals can be achieved more cheaply by direct methods than by intervention in particular commodity markets.

6.4 FOREIGN EXCHANGE

An argument sometimes used for expanding the size of the international civil aviation industry is that it generates foreign exchange. For example, this criterion was mentioned in the ICAP Report (Para. 7.15.1, p.232).

The context of this argument for regulation is that the country suffers an external imbalance but there is a variety of ways equilibrium can be restored. For example, the nominal exchange rate could be altered. If the exchange rate is fixed, then either the adjustment will occur via inflation or be brought about by changing the barriers to trade. The last option includes regulation of international civil aviation. These mechanisms can be distinguished by their redistributive effects. Use of trade restraints then implies a judgement has been made about the desirability of different sets of redistributive effects. Therefore, the foreign exchange argument for regulation is effectively making these judgements. Generally, economists would disregard the foreign exchange argument because they would assume other redistributive devices were available, to correct undesirable effects of the adjustment to external balance. From that viewpoint, and in

1 See Caves and Jones (1977) for a textbook review of these alternatives.
conclusion, the foreign exchange case for regulation ultimately must rest, first on the absence of alternative redistributive devices and, then, on a value judgment about desirable redistributive effects.

6.5 RISK

A country may not only be concerned with the distribution of income but also with the distribution of risk. Risk could be due to uncertainty about prices, related to the country's exposure to international trade, or the outcome of the production process. Initially this risk may be imposed upon people who are risk averse and who would be willing to trade risk, that is, to pay another person to bear the risk. The case for government intervention for risk redistribution must rest on some imperfection in this trade.

The risk distribution argument is not a straw man. For example, it is implicit in arguments that, with such large capital expenditure, transport industries like airlines need to be able to operate in a stable environment (and with government ownership (see Chapter 2)).

It is possible to imagine cases where complete trading of risk is possible. The least demanding of these is where there are as many securities (such as stocks, bonds, etc.) with independent patterns of return as there are states of the world. Share and bond markets exist but the total number of securities falls well short of the number of states of the world. In that case, markets are said to be incomplete and the implication is that not all risks can be traded.
This observation alone does not immediately imply there should be government intervention. There are good reasons why these securities or markets do not exist and if the government cannot relax the constraint of the incomplete markets, it cannot improve on the risk allocation achieved by those markets, which is called a constrained Pareto optimum (Diamond, 1967).

A risk spreading argument for government intervention has been developed. This argument is based on the model of Arrow and Lind (1970). The Government could decide to bear all the risk of a project if the project was independent of all others in the economy and if the number of taxpayers was very large. The explanation is that as the number of taxpayers increases, the risk borne by any one becomes very small so the risk premium they each require also becomes small. The aggregate premium also approaches zero. A mechanism for implementing this policy is government ownership, a characteristic of many international carriers.

The first comment on the Arrow and Lind argument is that when the government undertakes an investment it spreads the risk among all taxpayers but this distribution will not be efficient because risk is not distributed according to risk preferences. Arrow and Lind note this view (p.374) but point out that in their model, the diversion from optimality with regard to that particular risk will be small because it is spread over so many people.

A second comment on the Arrow and Lind result is that public ownership may not be necessary if other risk redistribution mechanisms were available. Indeed, if a share market exists in which people can costlessly trade claims to returns from the public project, the market will react exactly as Arrow and Lind say the
government should. Since the project is independent of others in the economy, its required rate of return will be the risk free rate.

This share market result indicates that arguments of the Arrow and Lind type for government involvement in the allocation of risks are based implicitly on the judgement that the costs of diversification of risk are less when undertaken by the government. This is not clear. For example, government ownership adds to the costs of risk bearing by its inefficient allocation of risk and the monitoring problems it creates (see Chapter 7). In conclusion, support for government intervention in markets for trading risk requires more evidence of the relative costs of diversification using market mechanisms and public intervention.

6.6 SUMMARY

A number of arguments for regulation were examined in this chapter. It was concluded that the natural monopoly argument was not relevant and that no case on grounds of imperfections in markets for trading risk had been established. The defence, and other externalities, argument was critically examined. Conditions in which the argument would be valid were described but a judgement on this argument requires evidence beyond the scope of this thesis. The approach subsequently adopted is that the externality argument could be valid but the cost of generating the benefits claimed should be made explicit through budgetary devices. A mechanism for doing this is described in Chapter 10 where the welfare gains from replacing regulation but its budgetary equivalent are discussed. Finally the foreign exchange argument was found to rest ultimately on a judgement about redistributive effects. The view is taken here
that distribution objectives can be pursued directly rather than by intervention in particular commodity markets.

The chapter completes the review of commonly used arguments for regulation. The next step, suggested by the model of Chapter 5, is to examine the cost characteristics of regulated airlines. An estimate of an air transport cost function is reported in Chapter 8 but first it is helpful to discuss hypotheses of the effect of regulation on airline costs. This is the topic of the next chapter.

Evident from Chapter 5 that cost differences will have important effects on the outcome of the bargaining process. In the negotiating process modelled in Chapter 4, the divergence between actual costs and those of the frontier carriers will determine the welfare cost of regulation, estimation of which is the topic of Chapter 9.

The first question to ask is what are the determinants of the costs of individual carriers? The obvious answer is that they will depend on technology available in each country and on factor prices. The influence of these variables could be illustrated by using a simple model of fixed air carrier operations (Focas, 1981). But also the existence of regulation, in particular, barriers to entry as well as ownership ownership, has been hypothesised in literature carriers below to increase costs. In section 7.5, a model of the regulated firm is presented in which this prediction is derived. Another question is, if regulation does raise costs above the level otherwise observed, what is the welfare significance of the cost increase? Is it all deadweight cost? The model is also applied to these questions.
CHAPTER 7: COSTS OF OUTPUT OF REGULATED FIRMS

7.1 INTRODUCTION

The main piece of econometric work reported in this thesis is the estimation of both a frontier cost function and the positions of particular carriers relative to the frontier. These estimates are reported in the next Chapter. There are a number of reasons for the emphasis on the relative costs of airlines. First, it is evident from Chapter 5 that cost differences will have important effects on the outcome of the bargaining process. In the negotiating process modelled in Chapter 5, the divergence between actual costs and those of the frontier carriers will determine the welfare cost of regulation, estimation of which is the topic of Chapter 9.

The first question to ask is what are the determinants of the costs of individual carriers? The obvious answer is that they will depend on technology available in each country and on factor prices. The influence of these variables could be highlighted by using a simple model of trade in aviation services (Findlay, 1981a). But also the existence of regulation, in particular, barriers to entry as well as government ownership, has been hypothesised in literature reviewed below to increase costs. In section 7.2, a model of the regulated firm is presented in which this prediction is derived. Another question is, if regulation does raise costs above the level otherwise observed, what is the welfare significance of the cost increase? Is it all deadweight cost? The model is also applied to these questions.
7.2 MANAGERIAL MODEL

7.2.1 The model

The problem in this section is to predict the effect of regulation on the costs of the firm. The approach adopted here is to write down a utility function for the management of the firm. Utility is then maximised subject to demand, technology and financial constraints. This method is typical of the literature on managerial theories of the firm. In this literature, managers are assumed to maximise a utility function which depends on some combination of output, labour input, managerial effort, managerial money income and the firm's profit. An attempt will be made here to specify a general utility function for managements, and one based on the ultimate determinants of management utility, that is, goods and leisure.

The first equation of the model is the managerial utility equation (1), in which utility is assumed to depend on leisure (L), money income (I) and perks (q). Aggregation conditions

$$U = U(I,q,L)$$

(1)

are assumed to be satisfied so income and perks represent composite commodities (see Green, 1976). Money income is used to buy goods

1 The problem of how managers solve their constitutional choice problem is sidestepped.


3 The cases where utility depends only on some combination of profit and output are not considered here. Examples of this group are Niskanen (1971) and Migue and Belanger (1974). In comparison to the issue here, this part of the literature is more concerned with welfare losses due to choice of output by managers.
and services in markets but there is no market in perks, which flow directly from the firm to the managers. Perks may be goods specific to the firm but could also be goods supplied by the firm for managerial use, although they could not be resold by managers to obtain a market bundle of goods.

In the model used here, it is assumed the managers make the decisions while shareholders receive profit. Managers may have some equity in the firm, indicated by the proportion $a$. If $a=1$, the model refers to an owner-manager.

Managers also face constraints due to demand and technology. These constraints are subsumed in the profit ($M$) function, written as equation (2), where $P$ is the product price, $T$ is output, $C$ is the cost of inputs (including a normal return to capital) other than managerial services, $E$ is managerial effort, $W$ is the salary paid to managers.

$$M = P(T)T - C(T, E) - W - q$$  \hspace{1cm} (2)

It is assumed here that the managers face a fixed product price, set by the bargaining discussed in Chapter 5. Thus total revenue ($R=P.T$) is given and output is not a decision variable, which rules out maximisation of output as way of characterising managerial preferences. A justification in other papers of this rule has been, in part, that managerial salaries are related to firm size but here $W$ is held fixed. In another regulatory environment, the embellishment of variable output, which also effects $W$, could be valuably added to the model. But here, given the view of negotiation of fares in Chapter 5 and the aim of avoiding any specific presumption about managerial preferences, this embellishment adds little.
It is possible that even within the model of Chapter 5, managers can have some influence on fares and hence output. The mechanism would be that the reaction of managers to the negotiated price could change the carrier's costs and lead to renegotiation of prices. However, it is assumed this process reaches an equilibrium, at which point the model applies. The model could also be complicated by distinguishing between passenger trips and flight frequency but the complication would add little to the model, except where frequency or trips directly entered the utility function. Again, the cost of the loss of this embellishment is small since an attempt is made here to avoid presuming specific types of managerial preferences.

The cost function in (2) depends on managerial effort \( E \); an increase in effort lowers the cost of producing a given output. Managerial money income \( I \) is the sum of managerial salary and the managerial share of profit, as shown in equation (3):

\[
I = aM + W
\]  
(3)

It is assumed managers face a time constraint where \( E \) is measured by time at work, so total time \( H \) must equal the sum of \( E \) and \( L \):

\[
H = E + L
\]  
(4)

Finally, various types of financial constraints can be imposed on the managers. For example, Albon and Kirby (1981) assume regulators set a maximum positive profit which the firm can earn. Gravelle and Katz (1976) examine effects of absolute and rate of return constraints. Yarrow (1976) makes the level of profit the firm must earn endogenous by modelling the incentives for shareholders to form a coalition to replace existing managers. Rees (1974) assumes a shareholder imposed profit constraint. Here it is assumed that the
shareholders demand only a minimum, here non-negative, profit. A justification for this assumption could be that shareholders lack the information to effectively monitor the performance of the managers, for example, so as to detect the extent managers are extracting perks from the firm. While managers continue to receive perks, it has been assumed that their salaries are fixed. This assumption could be justified by assuming, first, that salaries are more easily monitored by shareholders and, second, that the market for managerial services is not competitive (so the salaries are not bid down by the value of perks). These assumptions are made initially for simplicity and, later, both assumptions about shareholder activities and the market for managers are relaxed.

In summary, the financial constraints are that the managerial salary \( W \) is fixed and managers must earn at least zero profit. The latter assumption means that the value of perks is

---

1 This assumption is strictly inconsistent with the model of Chapter 5, where it was shown that some firms could never earn positive profit at the negotiated fares and frequency. If negative profits persist, either the firm would have to become government owned or be subsidised. Both cases are considered below in this, or later, chapters. In the meantime, the non-negative profit constraint can be treated as a characterisation of the case of losses, where for example, there is some maximum loss that will be tolerated by the shareholders, or their agents.

2 All other factor markets are assumed to be competitive and this assumption is also relaxed below.

3 The financial relationship between Qantas and the government was described in the latest Qantas Annual Report (1980-81). Qantas is a company all the shares in which are owned by the Commonwealth Government. There is a Board of Directors appointed by the Minister for Transport and the company management is responsible to the Board. Qantas is bound by a Financial Directive, issued in 1949, by the then Minister for Civil Aviation which defines the Board's responsibility and lays down the financial targets of the Commonwealth; required [contd.]
constrained by potential profit available. To make the model interesting, it is assumed the regulated price is high enough to generate potential profit in order for perks consumption, or extra leisure, to be observed. The managerial problem is then to maximise (1) subject to the constraints (3) and (4) (as well as positive \( M \) which is assumed to be not binding) and this problem can be summarised by the Lagrangean (equation (5)):

\[
H = U(I,q,H-E) + b(I-a(R-C(T,E) - W - q) - W)
\]

(where \( b \) is a Lagrangean multiplier).

The first order conditions are:

\[
H_I = U_I + b = 0 \quad (6)
\]

\[
H_q = U_q + ab = 0 \quad (7)
\]

\[
H_E = -U_L + abC_E = 0 \quad (8)
\]

which can be rearranged as (9) and (10):

\[
\frac{U_q}{U_I} = a \quad (9)
\]

\[
\frac{U_L}{U_I} = -aC_E \quad (10)
\]

The trade-off between income and perks is illustrated in Figure 7.1. In the diagram, OW is the managerial salary and the

---

1 If output had been a decision variable, \( T \) would have been set so \(-ab(R_T - C_T) = 0\) or in other words, at the profit maximising level.

2 This diagram is taken from Jensen and Meckling (1976). The model can be further complicated by introducing time, uncertainty and taxation and the last of these is discussed below.

3 Rates of return are not reported. The Commonwealth retained the powers, normally held by a Board, to provide capital, approve borrowings, investment, purchase and disposal of aircraft, approve capital expenditure above some limit, the application of profit, and the setting of executive staff salaries and other financial benefits. The Board claims Qantas cannot operate as a normal commercial enterprise.
Figure 7.1 Choice of Income and Perks
distance OA is the sum of salary and total profit available. If managerial equity was 100%, all profit could be consumed as perks so the constraint facing managers would have been the line AB. When equity is less than this, the constraint is swung toward the origin and in the case illustrated has become the line BG. At the optimum the slope of this constraint (equal to -a) is set equal to the ratio of the marginal utilities, illustrated by the tangency of the indifference curve $U_1$ to the line BG at the point K. At this point, perks consumed are O$q^*$, profit received by the managers is LD and the balance of AD is either absorbed as perks (AJ) or paid to shareholders (DJ).

The profit available will generally depend on managerial effort. Changing the effort level would then shift the constraint AB so the lines in Figure 7.1 are drawn assuming a given effort level. Changing effort would also generally change the indifference curves but this effect can be ignored here by invoking the separability assumption needed to form the aggregates used in the model. The trade-off between income and effort is illustrated in Figure 7.2.

In Figure 7.2, the slope of the constraint facing managers depends on managerial equity. In the diagram, OH is total time and UH is assumed to be the minimum effort required to earn a positive profit (a constraint not explicit in the maximisation problem). Extra effort, beyond UH, generates extra profit, shown by the line UM (assumed to be linear for simplicity, implying $C_{EE} = 0$). As managerial equity falls, the constraint the managers face flattens; generally the effect of changing managerial equity cannot be predicted because it depends on an income and a substitution effect.
Income in excess of $W$

Figure 7.2 Choice of Income and Time Effort
(noted by Corden (1974), Martin (1978) and Grenning (1981)). Even if managerial equity were zero, extra effort could still be positive because managers could consume extra perks.

7.2.2 Implications for X-inefficiency

As noted in the Introduction to this chapter, it has been argued that rents created by protection can be absorbed by higher costs (see, for example, Corden (1974)). In terms of another part of the literature, the firm is said to become X-inefficient. In this section, a definition is offered of X-inefficiency and the effects of managerial behaviour predicted by the model of the previous section are interpreted in terms of this definition.

The definition is illustrated in Figure 7.3. Shown in the Figure is a unit isoquant of a production function in which the only factors are labour (L) and capital (K). The production point is taken to be A, showing the combinations of labour and capital actually used to produce a unit of output. There are two types of inefficiency in this figure; the following definitions are due to Farrell (1957). The first is called technical inefficiency, due to production off the isoquant, and the degree of technical inefficiency is measured by the ratio $OA/OB$. In other words, the cost of a unit of output has been increased by a factor $OA/OB$ due to excessive use of both factors, holding factor proportions constant. In the figure, relative factor prices are given by the slope of the line through C and Z so that the cost minimising factor input ratio is

1 Technology is summarised by the unit isoquant when the production function is homothetic. This assumption is made here so inefficiency due to non-optimal scales of operation are ignored.
Figure 7.3 X-Inefficiency and Perks Production
shown by the ray OZ. The cost of failing to use this ratio is called allocative inefficiency. The degree of allocative inefficiency is measured by the ratio OB/OC. Total inefficiency is measured by the product of these two ratios, equal to OA/OC, and this total is referred to here as X-inefficiency.

The implications of the model of the previous section for X-inefficiency can also be illustrated in Figure 7.3. Temporarily ignore the choice of leisure and assume that production of perks consumes labour and capital. The perks budget, from the previous section, is Oq* and applying factor market prices, combinations of labour and capital which can be attained are shown by the line AD. The managers choice will lie somewhere on that line depending on the technology of the perks they prefer. The implication is that the firm will appear to be X-inefficient.

This model makes no presumption about the direction of X-inefficiency. The perks consumed could be completely labour intensive or capital intensive. Nor does the model suggest the direct inclusion of a particular factor in the utility function. Perks consumed may be zero and all potential profit absorbed as leisure. In that case the regulated firm would consume more of all factors than otherwise to produce a unit of output.

It might be objected that the use of the term 'X-inefficiency' to describe the result of managerial response to regulatory rents is inconsistent with its use by Leibenstein, the person originally associated with the concept. But recently, Leibenstein (1978) has emphasised the source of X-inefficiency is

---

1 For example, labour is included by Rees (1974), Williamson (1964) and Orzechowski (1977).
the discretion available to members of the firm as they make their
choices of levels of effort. In other words, X-inefficiency occurs
because constraints on behaviour are relaxed so agents can pursue
other goals than cost minimisation (Stigler, 1976). The model
used here reflects the spirit of this view of X-inefficiency. This
is evident by assuming that the product market becomes competitive.
Then managers' perks budget will be forced to zero and managers will
have to supply sufficient effort to minimise costs, subject to the
constraint of attaining the utility available in other managerial
positions. This comparison with competition emphasises one point;
it is that if the regulators can duplicate the pressure of
competition, for example by setting the zero profit price,
regulation need not lead to X-inefficiency.

In summary, in the model presented so far, managers have
discretion because of shareholders' monitoring problems and because
of the characteristics of regulation. Some part of the rent created
by regulation can subsequently be absorbed by the managers as X-
inefficiency.

7.2.3 Welfare implications

The model can be used to indicate the proportion of the
cost increase due to X-inefficiency which should be counted as

1 Stigler also included, in the view of X-inefficiency as due to
motivational factors, the cost of enforcing contracts. The
role of contracts is discussed again below. Stigler reports
that originally Leibenstein also had in mind inefficiencies in
markets for knowledge. This source of X-inefficiency is not
discussed in detail here; Leibenstein did not discuss it in
his 1978 paper and it could be included in the set of
motivational factors, since time spent searching for new
methods or products involves effort (Corden, 1974).
deadweight cost. An answer is illustrated in Figure 7.1. Currently in the model, the managers are faced with the constraint BG along which K is the utility maximising point. But the managers could be just as well off if faced by the constraint through S and T, along which N would be the utility maximising point. But the latter constraint leaves the other shareholders with profit of RS, which exceeds the profit previously available to them of RK (equal to JD). Therefore there is a cost involved in using the constraint BG because the same managerial utility could be achieved at less cost (of profit foregone) by the remaining shareholders (Stigler, 1976). A measure of this cost is KS. The cost occurs because managers are faced with incorrect relative prices of perks and income; a dollar of perks is worth a dollar to owners but less than that to managers whose equity is less than 100% (Parish and Ng, 1972). Extreme cases can be used to illustrate this point. If the managers have 100% equity, they will consume along BA and there will be no deadweight cost from perks production. If their equity is zero, they will consume at point B, and could be compensated by an amount less than the profits foregone of LA.

It is possible to make some observations about the likely size of the cost due to the inefficient pricing of perks. If perks are highly firm specific, the firm is likely to attract managers who value highly the perks the firm can generate. In that case, the indifference curves in Figure 7.1 will be steeper and the deadweight cost will be less.

It was evident from the discussion of the welfare costs of X-inefficiency that, in the model described so far, managers are employed on inefficient contracts. It was shown, in Figure 7.1,
managers could be no worse off but the owners could be better off if the managers were faced with a different trade-off between income and perks. The type of contract which would bring about these gains (the move from a point like K in Figure 7.1 to one like N) is the topic of the literature on agent-principal relationships (Shavell, 1979).  

In summary, the existence of X-inefficiency need not indicate there is a welfare cost involved. For example, even under an optimal contract managers may consume some perks. There will be a welfare cost when inefficient contracts are used to employ managers.

7.2.4 Managerial Labour markets

It is possible to complicate the model by introducing a competitive market for managerial labour. It remains possible

1 The relevance of this literature actually depends on there being uncertainty in the model. The reason is that, otherwise, the contribution of management actions to the firm's performance could be easily observed. There is only a monitoring problem if contributions of management and of the states of the world cannot be separately observed. This is the same condition that must hold for moral hazard to be a problem in insurance. When uncertainty is present, the income axis in Figure 7.1 could refer to an expected value and the indifference curves would then represent the preferences of risk neutral managers. The line through T, S and N could then constitute an optimal contract where the owners were risk averse, since then it is optimal for the owners to be guaranteed a constant profit while managers bear all the risks (Shavell, 1979).

2 Income tax could be introduced into the model and it will have a similar effect of driving a wedge between the private and social values of perks and leisure, both of which are not taxed.

3 It has also been implicitly assumed so far that managers cannot replace their own time by hiring outside labour (but see Ng (1974)) or sell their services to more than one firm.
for managers to consume perks and extra leisure but now competitive managers will bid down their salaries by the value of 'the easy life'. Ignoring the choice of leisure, the outcome is depicted in Figure 7.4. For simplicity it is assumed that the managers have zero equity so that otherwise they would have consumed at point B. But when the market is competitive, their wages are bid down to \( W' \), so they are as well off at C as at A, where no perks are earned. In this case, the value of the perks consumed is passed back to the owners of the firm.\(^1\)

7.2.5 Government versus private ownership

As reported in Chapter 2, the question of whether airlines should be owned by the government or by private shareholders has been an issue in Australian civil aviation policy. The effects of transferring between types of ownership can be examined with the aid of the model used here.

In the standard model of the government owned firm, the managers have no rights to the firm's profits. The firm is owned by the taxpayers but their shares are both very small and effectively not transferable. In that case, shareholders wealth is independent of the performance of the firm and, assuming the shareholders' objective is maximum wealth, they have no interest in monitoring the performance of the managers.\(^2\) Subsequently the managers run the

---

\(^1\) Fama (1980) has argued there will another pressure from the managerial labour market which will be to always minimise costs. The penalty of not doing so is argued to be lower wages in future positions. The problem with this proposition is that it is not clear how the market will generate the information required since it will have to solve the monitoring problem that faces the owners (Russell and Thaler, 1980).

\(^2\) Taxpayers may have this incentive in their role of consumers.
Figure 7.4 Competitive Management
Labour Market
firm to maximise their own utility. Potential profits might exist but they are all absorbed as perks or leisure (as modelled above) so the firm earns no profit but managers earn the rents (assuming managerial labour markets are not competitive). A private firm in this position would be taken over but since the shares are not transferable, the government firm cannot be taken over.

In summary, the owners of the government firm have little interest in monitoring managerial performance. Owners of the private firm have that incentive. Given the difficulties of monitoring, it is predicted the owners of the private firm will enter into the type of contract with managers discussed in section 7.2.3. Taxpayers have less incentive to enter that type of contract with managers of their firm. Hence the effect of changing from government to private ownership will be the same as moving from a non-optimal to an optimal contract, illustrated in Figure 7.1. One effect will be therefore to remove the deadweight cost associated with the inefficient pricing of perks. But also negotiation of the contract could lead to a redistribution of rents between owners and managers.1

7.2.6 Other input suppliers

It has been assumed so far that all inputs, other than managerial services are purchased in competitive markets. This need

---

1 See Davies (1971, 1977, 1980), Forsyth and Hocking (1980) and Albon and Kirby (1981) for discussion of this question in the context of Australian domestic civil aviation regulation. This debate is not entered here but it is possible to derive (using Figure 7.1) both the prediction that the government owned firm will and will not have higher costs than the privately owned firm, depending on how regulation is characterised.
not be the case and the model is now complicated by considering the
effects of a monopolist supplier of one of the other two factors
used in the model.¹

Assume that capital (K) is purchased on competitive markets
but that the local supply of labour (L) has been monopolised. If
the product market were competitive, this monopoly would be
worthless since any attempt to raise wages would raise costs so the
local firm would be driven out of business. But regulation involves
protection which can create rents in which the labour monopoly can
share. The next question is what type of bargains will be made?

It is assumed here that the bargains made will always be
efficient. This means that the managers and the union (the labour
monopoly) jointly maximise profit then distribute the profit between
themselves. This type of bargain will involve simultaneous fixing
of wages and employment.² The effect on efficiency in production
of introducing this type of bargain is illustrated in Figure 7.5.
Point C is the cost minimising combination of inputs at market
prices. This point would be chosen under the efficient bargain.
Potential profit generated, is then divided between managers and the
union. In the second stage, the union may allocate its share
between higher wages and easier working conditions, which can be

---

¹ It has been argued that US domestic regulation has benefited
airline employees by raising wages and improved conditions. See Jordan (1978).

² Inefficient bargains involve only wages. See de Menil (1971)
and McDonald and Solow (1980) for illustrations of the
inefficiency of this type of bargain when labour is the only
input but output is variable. The argument also applies when
product price is fixed and there is more than one input
(Warren-Boulton, 1977). There is evidence of efficient types
of bargains between Australian airlines and their pilots in
Figure 7.5 Monopoly Labour Supply
interpreted as more employees to fulfil the same labour task. For example, the effective labour input required is given by point C but the number of employees may correspond to point R. Higher wages actually paid are illustrated in Figure 7.5 as the slope of the line through J.

A complication is that while the union is allocating its share of the rents between wages and the number of employees, managers are also trying to produce perks with their share. These choices cannot be made independently; for example in Figure 7.5, point R must both generate the perks required by managers (determined in the diagram by point M) and be consistent with union preferences on employment. The constraint facing the managers is shown by the line NQ, the slope of which is determined by actual wages paid.

Once again the firm will exhibit both technical and allocative inefficiency but the measures of the costs of these inefficiencies will depend on the price line used. For example, say the firm is at point M then the cost of technical inefficiency is OM/OD. But there are two measures of allocative inefficiency, OD/OB and OD/OA. The former is correct because it is based on the opportunity cost of labour.

The presence of the labour union will lead to a different allocation of potential rents but it can be assumed that the whole of the union's share corresponds to utility to the union. In other words, there is no deadweight loss from labour employment contracts.

7.3 SUMMARY

Regulation by its pricing rules can create rents but it is difficult to predict how the rents will be distributed. It is
expected the regulated firm will appear technically inefficient but
the type of inefficiency is difficult to predict. Government
ownership will raise the level of technical inefficiency.
Absorption of rents by higher cost operations need not indicate a
deadweight cost but will do so when managers are employed on
inefficient contracts. These predictions of the model are valuable
in the specification and testing of the cost equation in the next
chapter and in the welfare analysis of Chapter 9.
8.1 INTRODUCTION

The previous chapter reported a model which predicted differences in costs of regulated carriers. These differences were due, firstly, to differing factor prices (assuming all firms have access to the same technology) and, secondly, to regulation itself. Regulation, by price and entry control can create rents which may be absorbed (although not necessarily wasted) as higher costs, depending on managerial preferences and constraints on managerial choice. The latter constraints were hypothesised to vary with the firm's ownership characteristics. The aim of this chapter is to summarise the data available on costs of international carriers and examine their variation with factor prices and ownership type. Even within an ownership group, there is still expected to be variation in costs depending on managerial behaviour, and other random factors. This variation will be exploited to derive a frontier cost function and, subsequently, measures of efficiency. The method of summarising the data and estimating the frontier is to use econometric methods to estimate a cost function for international air transport.

There are other cost models available for civil aviation, including those of NASA (Maddalon, 1978, Maddalon, Molloy and Neubauer, 1980) and the United States CAB (1980). These studies disaggregate costs to a great degree then relate each item, by econometric methods, to various airline characteristics. In terms of the model specified below, these studies hold factor prices fixed and they estimate an average function rather than a frontier. Given
the data available and the objectives here, these studies are not helpful.

Another method of measuring airline efficiency is to estimate average factor productivity ratios. Examples are Forsyth and Hocking (1978a) and Findlay (1979). There are numerous difficulties in these studies. For example, it is necessary to allow for varying factor prices when comparing the productivity of individual factors in different airlines. The comparisons should ideally be standardised for the characteristics of output. The econometric method used here allows for these variations. The econometric method also facilitates estimation of an overall efficiency measure which is not easy in the factor productivity method.¹

These criticisms of other methods should not be taken to imply the method used here is faultless. There could be many errors in the results, for example due to problems in the data or misspecification of the estimated equation. The econometric method is used because it is the best way of summarising the available data on airline costs and their relationship with output, factor prices and other variables. One final point to emphasise is that the data used here refer only to one aspect of the total cost of air travel. The total cost, as defined in Chapter 3, includes both costs of delay and of resources used in providing capacity. The attention of this chapter is restricted to the latter component.

¹ Total factor productivity is estimated by Caves, Christensen and Tretheway (1979). They compare their total estimate with cruder measures (like available ton-miles per employee) and find major differences in the results.
8.2 ESTIMATION METHOD

8.2.1 Introduction

Let $C$ be total cost, $y$ be output, and $p$ be a vector of input prices then the cost function can be written

$$C = f(y, p)$$

The function $f(.)$ is derived by minimising the costs of producing $y$ given $p$ and can be regarded as the frontier. For a number of reasons, actual costs will lie above the frontier. These include the technical and allocative inefficiencies described in Chapter 7. Costs will also vary due to a random element outside the control of the firm. These two sources of variation can be incorporated by adding an error term composed of two parts. One is a symmetric component that permits random variation across firms and the second is a one sided term that captures the inefficiency effects. Now let $C$ be actual costs so

$$C = f(y, p) \exp(v+u)$$

where $\exp(v)$ is the random term and $\exp(u)$ is variation due to inefficiency ($u > 0$).

The method used here is to estimate a cost frontier by applying ordinary least squares (OLS) to the stochastic specification of the cost function and adjust the constant term by $E(u)$ to obtain the frontier. The estimation method is discussed below but first it is useful to note the advantages and disadvantages of this general procedure.\(^1\)

---

\(^1\) See Forsund et al (1980) and Kopp (1981) for surveys of methods of estimating frontiers. By the classification of the former paper, the method used here produces a 'deterministic stochastic' frontier.
The advantages are that the estimation method is simple and the data requirements (output, input prices and cost shares) are not overwhelming. The estimates will be unbiased because output (under regulation) and prices of inputs can be regarded as exogenous. Finally, flexible but specific functional forms can be used to allow varying degrees of scale economies and factor substitutability. The disadvantages are that, while a distinction was made between sources of the error term, an estimate of the cost of inefficiency for each observation can only be obtained by confounding these sources. Also, it is not possible to obtain separate estimates of technical and allocative inefficiency.\textsuperscript{1} However, this is not an important problem since it was not possible in Chapter 7 to predict which type of inefficiency would dominate, nor is the distinction relevant for the calculation of the deadweight cost.

The next step is to discuss the specification and estimation of the model in more detail, under the headings

(1) variable cost function
(2) functional form
(3) estimation of the frontier
(4) measuring output
(5) statistical estimation
(6) pooling data

8.2.2 Variable Cost Function

The specification of a variable (or short run) cost function is discussed by Brown and Christensen (1980) and by Caves, \textsuperscript{1}In a more complex model, separate estimates can be made; see Schmidt and Lovell (SL) (1979, 1980).
Christensen and Swanson (1980). Assume there are three factors, labour (L), fuel (U) and capital (K). In the short run, K is regarded as fixed and the firm's problem is to minimise variable cost, by choosing L and U, subject to K and Y (an index of output). The solution is the variable cost function

$$CV = f(Y, P_L, P_U, K)$$

where $$CV = P_L L + P_U U$$, $$Y = Y(L, U, K)$$ and P refers to factor prices.

A variable cost function will be estimated here, for two reasons. First, the assumption of a fixed capital stock is plausible in the annual time periods used here. Second, and more pragmatically, while it is possible to specify the appropriate cost of capital and a measure of the services of capital, the data requirements are very demanding. If an attempt were made to measure these items, a number of assumptions would have to be made and the data would then contain considerable inaccuracies. For this reason, and given the plausibility of the short run model, it was decided to estimate the CV function.

A measure of the capital input is still required but this is less demanding than measuring the cost of capital. It is proposed here to use a physical measure rather than a value. Before describing the measure of capital, it is helpful to point out the

---

1 See Officer (1981) for discussion of the cost of capital. Data required for a measure of the cost of capital and value of capital services include the company tax rate, values of debt and equity, the cost of debt, the risk free rate of return, a measure of systematic risk and the return on a market portfolio, opening and closing period values of capital items and their rates of depreciation (physical).
characteristics of the short run function. First its partial derivatives have the following signs:\(^1\)

\[
\begin{align*}
CV_Y & > 0 \\
CV_L & > 0 \\
CV_U & > 0 \\
CV_K & < 0
\end{align*}
\]

The explanation of the last sign is that increasing the fixed factor will raise the productivities of \(L\) and \(U\) so a smaller quantity of those inputs will be required to produce the same output. Thus \(CV\) will fall, or at least stay the same. Other relevant properties are that the function will be homogeneous of degree one in prices and will be concave in factor prices.\(^2\)

Another important property of the cost function is that, using Shephard's Lemma, the derivative of the log. transformation with respect to a factor price is equal to the share of that factor in variable costs. This characteristic provides valuable information which is used in the estimation process.

Aircraft are the major single item of capital in an airline.\(^3\) The measure of capital used here reflects the capacity of this fleet. A difficulty is that since aircraft are lumpy, both the numbers (\(N\)) and average capacity (\(A\)) of the fleet will have separate effects on variable costs, the former likely to be positively related to \(CV\) and the latter, like \(K\) in the general model, negatively related.

---

1 The \(L\) and \(U\) subscripts refer to changes in factor prices.

2 See Varian (1978) for discussion of the properties of cost functions. Concavity means the matrix of second derivatives (\(CV_{ij}\)) will be negative semi-definite.

3 For example, in Qantas' case fleet accounted for about 60% of estimated value of assets (see Appendix to Chapter 9).
8.2.3 **Functional Form**

The estimated equation is a special case of the translog variable cost function (Brown and Christensen, 1980). The estimated equation can be written

\[
\ln CV = a_0 + a_Y \ln Y + a_L \ln P_L + a_U \ln P_U + b_1 \ln A + b_2 \ln N
\]

\[+ (1/2)c_{LL}(\ln P_L)^2 + c_{LU}\ln P_L\ln P_U + (1/2)c_{UU}(\ln P_U)^2\]

In comparison to the more general form¹ a number of restrictions have been imposed; these are

(a) symmetry \((c_{LU} = c_{UL})\)

(b) the effects of price changes are independent of the levels of output and the fixed factors

(c) cost is homogeneous in output, in other words, the degree of scale economies is independent of the level of output.

Also the restriction is imposed that the cost function is homogeneous of degree one in input prices which means

\[
a_U + a_L = 1
\]

\[
c_{LU} + c_{UU} = 0
\]

\[
c_{LU} + c_{LL} = 0
\]

The function can be further restricted to a Cobb-Douglas form by assuming

\[
c_{LL} = c_{LU} = c_{UU} = 0
\]

These restrictions, which would lead to a form similar to that used by Mackay (1979), were not adopted because they restrict the elasticity of substitution to be unity, which appears too high,

---

¹ One difficulty in using the translog form is that it cannot be solved for the corresponding production function so that it must be interpreted as an approximation.
given studies of US trunk carriers (Caves, Christensen and Tretheway, 1980).

8.2.4 Estimation of the Frontier

Broadly, the approach is to adjust the constant term so that the estimated equation becomes the frontier but within this method there are two questions;

(a) estimation of a single equation or a system
(b) method of adjusting the constant

(a) single equation or system

The options are to estimate just the cost function or the cost function and share equations. The system is estimated here. The reason is that the share equations, which for the equation to be estimated, can be written,

\[ S_u = a_u + c_{LU} \ln P_L + c_{UU} \ln P_U \]

\[ S_L = a_L + c_{LU} \ln P_U + c_{LL} \ln P_L \]

contain information about the parameters which would otherwise be ignored. The value of this information is that it can improve the efficiency of the estimates (Christensen and Greene, 1976).

(b) adjusting the constant

Two methods are available for adjusting the constant. The first is to shift the value down until no residual is negative. This method provides a consistent estimate of the true intercept of the frontier (Greene, 1980). This result can be illustrated as follows; for simplicity, let

\[ \ln CV = a_0 + a_Y \ln Y + \sum_i a_i \ln P_i + u \]

where \( u \) is a one-sided error term and positive. Let \( \bar{u} \) be its mean
then

\[ \ln CV = (a_0 + \bar{u}) + a_Y \ln Y + \sum_{i} a_i \ln P_i + (u - \bar{u}) \]

so the error term in this equation satisfies the usual conditions. The estimate of the intercept is then

\[ a_0' = a_0 + \bar{u} \]

so

\[ a_0 = a_0' - \bar{u} \]

Therefore, the first method is equivalent to assuming that the mean of the distribution is that value which makes all the residuals non-negative.

The second method of adjusting the constant is to assume a particular distribution of \( u \) then if the parameters of this distribution can be derived from its moments, they can also be derived from the residuals of the estimation procedure. In that case, the mean of the distribution can be estimated and used to adjust the constant term (Richmond, 1974). A disadvantage of this method is that even after correction, some of the residuals may have the wrong sign which makes it awkward to obtain firm specific measures of inefficiency. Both methods of adjusting the constant term are tried.\(^1\)

8.2.5 Measuring output

A basic measure of airline output is tonne-kilometres performed (TKP) but airline output has a number of dimensions. In

---

\(^1\) If a specific distribution of the error term is assumed, this information can be incorporated in a maximum likelihood estimation procedure (Greene, 1980).
particular, as suggested by Sarndal and Statton (1975) and Sarndal, Oum and Statton (1978),

\[ Y = L \cdot S \cdot C \cdot F \cdot A \]

where \( Y = \text{TKP} \)

\( L = \text{load factor} \)

\( S = \text{average stage length} \)

\( C = \text{number of cities served} \)

\( F = \text{average departures per stage} \)

\( A = \text{average capacity per flight} \).

One approach to incorporating these characteristics in the cost function is suggested by Spady and Friedlaender (1978) who combine the characteristics in an index \( H = H(Y, L, S, C, F, A) \) so the cost function becomes

\[ CV = f(H, P_U, P_L, K) \]

This function is actually part of a larger system but unbiased estimation requires the right-hand-side variables to be independent of \( CV \). To illustrate this problem, it is useful to add the other equations in the system. These are a demand equation,

\[ Y = D(P, L) \]

a load factor relation

\[ L = Y/(S \cdot C \cdot F \cdot A) \]

and an aircraft choice function

\[ A = A(Y, L, S, C, F, P_L, P_U) \]

The last equation says that aircraft choice will depend on scale of output, route structure, service quality and factor prices. A possible link between these output characteristics, summarised by \( H \), and \( CV \) is via the price term (\( P \)) in the demand equation. Here it is assumed that in the time period of interest,
price is taken as given by the airlines. Even if price were fixed, higher CV could cause airlines to lower F and raise L but here it is assumed that either F or L are also fixed in the regulatory system. In the period of interest the route structure is taken to fixed and independent of CV. Finally, in the long run, A will be influenced by the same factors that determine CV but here is regarded as part of the fixed factor K.

While it is possible to argue that, in a regulated environment, these output dimensions are exogenous with respect to CV they should not all be included in the estimated equation since they are linked by an identity. It is not clear which dimension should be dropped so various combinations will be tested.

The next problem is to choose a form for the function H. Spady and Friedlaender use a translog form but that choice leads to a large number of parameters. Here it is assumed that H is a logarithmic function

$$\ln H = \ln Y + \sum_{k} a_k \ln t_k$$

where the $t_k$ refer to dimensions of output.

8.2.6 Statistical method

The estimation procedure involves the addition of error terms to the cost and share equations. In the case assumed here, where input ratios are independent of the level of output, the error term on the share equation is solely due to allocative inefficiency but the error on the cost equation reflects both allocative and technical inefficiency. This means the error terms are not
independent. Use of the information that error terms are related will lead to more efficient estimates (Kmenta, 1971, pp.517-529). The method of incorporating this information is seemingly unrelated regression or Iterative Zellner estimation (also used by Christensen and Greene (1976)).

A complication here is that since the shares sum to one, the error terms on the share equations must sum to zero. The estimation method uses the disturbance covariance matrix which will be singular if the errors sum to zero so one equation must be dropped. Christensen and Greene quote results, first that the estimates will be invariant to the equation dropped when ML estimates are obtained and, second, that the Iterative Zellner method converges to ML estimates.

8.2.7 Pooling data

Data sources were company reports and ICAO annual statistical publications. (Data are discussed in more detail in the appendix to this chapter). These sources offer the opportunity to combine cross-section and time series data. Let index m refer to a firm and let subscript t refer to a time period and assume a Cobb-Douglas form for simplicity, then the cost function can be written

\[ \ln CV = a^m_{Ut} + a^m_{Yt} \ln y^m_t + a^m_{Ut} \ln P^m_t + a^m_{Lt} \ln L_t + a^m_{Kt} \ln K^m_t \]

1 The SL model makes the relationship between the errors explicit and uses maximum likelihood estimation (ML) methods to obtain separate estimates of each type of inefficiency. The error terms will also reflect the influence of any incorrectly excluded variables.
In the most general specification, parameters would vary across firms and time but here the following assumptions are made:

1) over the period of estimation (1978 and 1979), technological change was small and parameters for one firm will be constant so

\[ a_{m0t} = a_{m0}, \]
\[ a_{mYt} = a_{mY}, \]
\[ a_{mUt} = a_{mU}, \]
\[ a_{mLt} = a_{mL}. \]

2) All firms share the same technology so parameters across firms will be equal:

\[ a_{U} = a_{0}, \]
\[ a_{Y} = a_{Y}, \]
\[ a_{U} = a_{U}, \]
\[ a_{L} = a_{L}. \]

One exception in this case is that in the estimated equation a dummy variable is added to test the effect of government ownership on variable costs. The same assumptions apply to the coefficient on capital stock.

8.2.8 Summary

The equation estimated is a variable cost function of the form

1 A similar study (applied to a different sample) is one by Caves, Christensen and Tretheway (1980). They estimate a translog function with three variable factors (capital and materials, labour and energy) as well as a variable cost version where only two factors were variable (labour and energy). Their output measures are an aggregate for passengers and freight carried as well as average stage length and average load factor (so they omit both total departures and average capacity per flight). They test the influence of [contd.]
\[
\ln CV = a_0 + a_1 \ln Y + a_u \ln P_U + a_l \ln P_L + b_1 \ln A + b_2 \ln N + a_1 \ln L \\
+ a_2 \ln E + a_3 \ln D + a_4 \ln (PF) + (1/2) c_{LL} (\ln P_L)^2 \\
+ c_{LU} \ln P_L \ln P_U + (1/2) c_{UU} (\ln P_U)^2 + d_1 DO + d_2 DC 
\]

with a fuel share equation given by
\[
S_U = a_u + c_{LU} \ln P_L + c_{UU} \ln P_U
\]

where

- \(CV\) = variable cost
- \(Y\) = TKP
- \(P_L\) = price of labour
- \(P_U\) = price of fuel
- \(N\) = number of aircraft
- \(A\) = average aircraft capacity
- \(L\) = load factor
- \(E\) = average stage length
- \(D\) = total departures
- \(PF\) = passenger/freight mix
- \(DO\) = government ownership dummy (\(DO = 1\) if government owned)
- \(DC\) = proportion of fleet as DC10's in 1979
- \(S_U\) = fuel share of variable cost

1 network size, measured by route miles and they separate freight and passenger output measures. Their cost function is not as restricted as that estimated here. On the other hand they do not attempt to estimate a frontier. Their main emphasis is to test the presence of scale economies. Their cost function is estimated using a combination of time series and cross section data for U.S. trunks and they allow the intercept to vary between firms. Their scale economy results were discussed in Chapter 6 and their elasticity estimates are compared below with those obtained here.
Two sets of parameter estimates are reported in Table 8.1. The estimates are distinguished by the method of measuring the wage variable. Ideally, as argued in the previous chapter, this variable measures the relative wage paid if labour markets were competitive. One estimate is the wage paid in other industries (called the UN wage). Another estimate is based on the assumption that some types of airline workers might be hired in competitive markets. Here it was assumed that markets for ticketing, sales and other promotional personnel were competitive and average wage paid to that group (called the ICAO wage) was used as the index of labour cost. The two wage measures are highly correlated (simple correlation coefficient of 0.69)\(^1\) and as illustrated below the results were very similar.

Parameter estimates, all significantly different from zero, from the final equations, are reported in Table 8.1.\(^2\) Interpretation of these estimates is given below but now it is important to comment on excluded variables.

\(^1\) The sample size for this calculation was smaller than both sample sizes used in the regressions since both wages variables were not always available for each observation. If the interpretation of the wage variable is not correct but there is a uniform degree of monopoly power in all observations then the elasticity estimate will not be biased but the estimated position of the frontier will be too high. If the degree of monopoly is varying the elasticity estimate could be biased.

\(^2\) Homogeneity restrictions imposed on the parameters are reflected in the parameter estimates in Table 8.1. Other desirable characteristics are that the cost shares predicted should be positive and that the cost function be concave in factor prices. These conditions are satisfied.
The DC dummy variable, included to test the effect of the DC10 groundings in 1979, was not significant and so was excluded. Average aircraft size (A) was not significant either, a result which was surprising since labour productivity was expected to be positively related to A. An explanation for this result was that in the samples, A was highly correlated with average stage length (E), as might be expected. Since route characteristics were regarded as more fundamental than aircraft type, A was dropped. The size of the aircraft fleet (N) was significant in early estimates but it was highly correlated with TKP (Y) and with departures (D). Since the latter pair were regarded as basic determinants of variable costs, fleet size was also excluded. Therefore the final equation reflected none of the influence, directly, of the fixed factor (K). The influence of K was expected to be operating through route and output characteristics. This result suggests it would be appropriate to estimate a long run cost model with annual data. Finally, coefficient estimates for load factor (L), stage length (E) and passenger/freight mix (PF) were all insignificant. Thus the only output characteristics remaining in the final equation were TKP (Y) and total departures (D). The insignificance of other output characteristics is surprising, although the influence of E and L could be reflected via the departure variable.¹

¹ Caves, Christensen and Tretheway (1980) found both average stage length and average load factors had a significant negative effect on costs but they did not test the influence of total departures. It could be that excluded aspects of output, such as total departures and average flight capacity, even though not significant in the international sample used here, could explain the firm specific effects (rising intercept with firm size) that Caves et al observe.
### TABLE 8.1: Results

**Equation - Wage Variable**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ICAO</th>
<th>UN</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_0$</td>
<td>-11.56 (30.36)***(1)</td>
<td>-7.84 (24.97)***(1)</td>
</tr>
<tr>
<td>$a_y$</td>
<td>0.72 (18.77)***(3)</td>
<td>0.84 (25.80)***(3)</td>
</tr>
<tr>
<td>$a_L$</td>
<td>0.37 (8.85)***(1)</td>
<td>0.84 (70.56)***(1)</td>
</tr>
<tr>
<td>$a_U$</td>
<td>0.63 (15.16)***(1)</td>
<td>0.16 (13.73)***(1)</td>
</tr>
<tr>
<td>$a_3$</td>
<td>0.11 (2.57)**(1)</td>
<td>0.06 (1.39)**(1)</td>
</tr>
<tr>
<td>$c_{LL}$</td>
<td>0.06 (8.91)***(1)</td>
<td>0.08 (9.41)***(1)</td>
</tr>
<tr>
<td>$c_{LU}$</td>
<td>-0.06 (8.91)***(1)</td>
<td>-0.08 (9.41)***(1)</td>
</tr>
<tr>
<td>$c_{UU}$</td>
<td>0.06 (8.91)***(1)</td>
<td>0.08 (9.41)***(1)</td>
</tr>
<tr>
<td>$d_1$</td>
<td>0.15 (1.82)**(2)</td>
<td>0.15 (2.39)**(3)</td>
</tr>
</tbody>
</table>

**Notes**
- t-values in brackets; significance levels:
  - ***: 1% for a two-tail test.
  - **: 5% for a two-tail test.
  - *: 10% for a two-tail test.
  - (3): 1% for a one-tail test.
  - (2): 5% for a one-tail test.
  - (1): 10% for a one-tail test.
8.4 APPLICATIONS

8.4.1 Scale economies

Since output has a number of dimensions, there are different types of scale economies. First, if the number of departures is fixed but TKP rises by 1% then CV will increase by 0.72% from the ICAO equation (or by 0.84% from the UN equation).

These results indicate there are scale economies when TKP increases, which is plausible since greater TKP with fixed departures means that load factor is higher, aircraft size is greater or stage lengths are longer or all three changes occur. All these changes would be expected to lower unit CV.

A second type of scale economy occurs when the number of departures increases but TKP stays the same. In this case a 1% rise in D would raise CV by 0.11% (0.06%). The usual type of scale economy would occur if D and TKP changed by the same proportion; in this case a 1% rise in both would raise CV by 0.83% (0.90%).

In summary, these results indicate there are scale economies in variable costs. These results need not imply scale economies in the long run with respect to all costs, when all factors are variable.

8.4.2 Elasticities of substitution and demand

The elasticities of variable cost with respect to factor price changes are given by the predicted cost shares of 0.26 for fuel and 0.74 for labour (0.24 and 0.76 respectively). The

---

1 In the following sections, numbers in brackets are results from the UN equation.
elasticity of substitution is 0.68 (0.56) indicating labour and fuel are substitutes.\(^1\)

Finally, labour and fuel demand elasticities are -0.18 and -0.50 respectively (-0.13 and -0.42 respectively). Both factor demands are therefore inelastic.\(^2\)

8.4.3 Government ownership

The model presented in Chapter 7 predicted that government owned firms would have higher costs than privately owned firms. This hypothesis is supported by the positive sign on the government ownership dummy variable. If a firm changed from private to public ownership its variable costs would be expected to rise by 16\% (from both the ICAO and UN equations).

8.4.4 Frontier cost function

The previous result indicates that only privately owned firms will be relevant for defining the frontier. These firms were ranked by the difference between actual and predicted variable costs. The twelve firms with the greatest (negative) differences are listed in Table 8.2. The interpretation of 'prediction error'

---

1 Of course, using two factors and a 'well behaved' cost function will restrict the factors to be substitutes but the degree of substitutability was not imposed. If the Cobb-Douglas form had been used, the elasticity of substitution would have been unity. Sources of the substitute relationship could be via aircraft size or via the speed with which aircraft are flown.

2 Caves, Christensen and Tretheway (1980) only report (see their Table 2) elasticity estimates for the model where all three factors are variable. In that case, labour and energy were complements and the other two pairs were substitutes. (Some of the components of the capital and materials factor defined by Caves et al are likely to be contained in the labour variable as defined here). All factor demands were inelastic.
is that, for example, variable costs of Texas are 32% below predicted (ICAO equation, 1979). The average error of the top twelve is 30% (29%) and this amount could be used as the adjustment for the intercept.

The other method of adjusting the intercept is to assume a distribution for the errors due to inefficiency, use the residuals to estimate the mean of that distribution then reduce the constant by the mean. One distribution, used by Richmond (1974), has the mean and the variance equal, in which case the least squares residual variance is an unbiased estimate of the mean. In this case, the mean is estimated to be 10% (7% from the UN equation).

8.4.5 Results for Qantas

In both periods, Qantas lies close to the position predicted for a government owned firm facing its factor prices. In 1978, its costs exceeded those predicted by 4% and equalled them in 1979 (the same results were obtained from both the ICAO and UN equations). Hence sale of Qantas is predicted to have the effect of lowering variable costs by the amount predicted by the coefficient on the government ownership dummy variable.

The results obtained so far can be illustrated with the aid of Figure 8.1. In the Figure, three variable cost functions are drawn (assuming 'output' refers to an index of TKP and departures). The lowest, marked 'frontier', is the variable cost frontier; the curve marked 'private' is the predicted cost function for privately owned firms and similarly for the curve marked 'government'. The government function is 16% above the private ownership function while the frontier is 10% (or 7% depending on the wage variable
### TABLE 8.2: Frontier Points

<table>
<thead>
<tr>
<th>ICAO EQUATION</th>
<th>UN EQUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OBSERVATION</strong></td>
<td><strong>ERROR(^b)</strong></td>
</tr>
<tr>
<td>Nordair 1979</td>
<td>0.70 (50%)</td>
</tr>
<tr>
<td>Nordair 1978</td>
<td>0.69 (50%)</td>
</tr>
<tr>
<td>Japan Asia 1979</td>
<td>0.66 (48%)</td>
</tr>
<tr>
<td>Texas 1979</td>
<td>0.38 (32%)</td>
</tr>
<tr>
<td>SAM 1979</td>
<td>0.36 (30%)</td>
</tr>
<tr>
<td>Western 1978</td>
<td>0.27 (24%)</td>
</tr>
<tr>
<td>Continental 1979</td>
<td>0.26 (23%)</td>
</tr>
<tr>
<td>JAL 1978</td>
<td>0.25 (22%)</td>
</tr>
<tr>
<td>CPAir 1979</td>
<td>0.23 (21%)</td>
</tr>
<tr>
<td>JAL 1979</td>
<td>0.21 (19%)</td>
</tr>
<tr>
<td>Laker 1978</td>
<td>0.20 (18%)</td>
</tr>
<tr>
<td>National 1979</td>
<td>0.18 (17%)</td>
</tr>
</tbody>
</table>

**Notes**

a Privately owned firms only.

b Predicted minus actual of log transformation of CV function. The percentage figure in brackets is the gap between predicted and actual costs, as a proportion of predicted.
Figure 8.1 Results
used) below the private ownership function. The shape of the curves reflects the scale economy result and the curves are drawn for a given set of factor prices.

To illustrate the results for Qantas, assume Qantas's output is marked Q. Then Qantas's actual costs \((CV_Q^A)\) were found to lie close to those predicted on the government function. Sale of Qantas to private owners is predicted to lower variable costs to \(CV_Q^P\). If the frontier could be reached, Qantas's variable costs would be \(CV_Q^F\), which is estimated to be 23% less than \(CV_Q^A\).

The next step is compare Qantas's costs with those of other operators who could operate Qantas's routes but who face different prices. These airlines are listed in Tables 8.3 and 8.4. Airlines chosen either operate to Australia (Air India, Air Niugini, Air New Zealand, Garuda, MAS, SIA, Thai International, Lufthansa, BA, Continental, CP Air, JAL, Pan Am) or have applied to operate to Australia (Laker, BCal) or are based in the region (KAL), as well as being included in the data sets used in the estimation procedure. The method of comparison was to estimate the cost frontier for each of these airlines (by adjusting the constant term in their cost equation and inserting local factor prices and output characteristics) then compare this frontier cost estimate to actual cost to obtain an efficiency measure. Then Qantas's output characteristics and fuel price\(^1\) were inserted in the frontier equation with the airline's local wages and an estimate was obtained of the minimum cost at which the airline of interest could provide Qantas service. This estimate and the inefficiency measure of each

---

1 Values inserted were the average of 1978 and (real) 1979 Qantas output and fuel prices.
airline were added to obtain an estimate of the actual cost of providing Qantas's service. This actual cost estimate summarises the influence of local wages and efficiency. For example, a carrier might be relatively inefficient but have such low wages that it could still undercut Qantas.

Tables 8.3 and 8.4 report data on the efficiency of each carrier listed relative to its own frontier and report its costs of providing Qantas's service relative to Qantas's costs. To illustrate, Thai International (from Table 8.3) has variable costs 13% above its frontier and its cost of provision of Qantas's service is 60% of Qantas's cost.

8.4.6 Minimum cost operator

The welfare analysis of the next chapter requires an estimate of the cost level of the least cost operator. This level is estimated as 60% of Qantas's costs. Examples of firms operating at this level are Thai International and KAL. In Table 8.3, Laker was estimated to be able to provide Qantas's service at even lower cost. This figure was not used as the least cost level because, even though the freight/passenger mix variable (defined in the Appendix) was not significant in the cost equation, this figure for Laker (of 33%) was much less than the average for all firms (of 67%) so the Laker operation appears atypical.

A number of comments on the estimate of the least cost level are helpful. First, it refers only to variable costs so

---

1 The frontier is here defined as the estimated equation for privately owned firms less the estimate of 10% (7%) for the mean of the one-sided distribution.
adjustment has to be made to predict the least cost level of total costs. Second, the 60% figure includes the inefficiency of Thai and KAL. In competition, the distance these firms lie above their frontiers (see Tables 8.3 and 8.4) could be reduced in which case the figure used will be an overstatement of the least cost level. Third, it is assumed a number of firms could operate at the minimum cost level estimated; if this were not the case the true least cost operator would earn a rent.

A final comment on the estimates of this chapter is that they are derived using a specific set of exchange rates (see Appendix). A change in exchange rates would change both actual costs (in terms of $US) and the factor prices so the estimates of the degree of technical efficiency may not be affected significantly but the relative positions of the carriers would change.
### TABLE 8.3: Airline Efficiency and Costs of Qantas's Service (%) (ICAO Wage)

<table>
<thead>
<tr>
<th>Airline</th>
<th>1978 Efficiency</th>
<th>Qantas</th>
<th>1979 Efficiency</th>
<th>Qantas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laker</td>
<td>-10</td>
<td>43</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Thai</td>
<td>13</td>
<td>60</td>
<td>9</td>
<td>64</td>
</tr>
<tr>
<td>KAL</td>
<td>n.a.</td>
<td>n.a.</td>
<td>6</td>
<td>61</td>
</tr>
<tr>
<td>MAS</td>
<td>-28</td>
<td>62</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>CPAir</td>
<td>12</td>
<td>71</td>
<td>-12</td>
<td>68</td>
</tr>
<tr>
<td>BCAL</td>
<td>21</td>
<td>78</td>
<td>13</td>
<td>72</td>
</tr>
<tr>
<td>Garuda</td>
<td>194</td>
<td>75</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>SIA</td>
<td>20</td>
<td>80</td>
<td>36</td>
<td>81</td>
</tr>
<tr>
<td>Continental</td>
<td>-4</td>
<td>82</td>
<td>-14</td>
<td>84</td>
</tr>
<tr>
<td>Air India</td>
<td>102</td>
<td>87</td>
<td>115</td>
<td>92</td>
</tr>
<tr>
<td>Air Niugini</td>
<td>257</td>
<td>94</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Pan Am</td>
<td>15</td>
<td>104</td>
<td>0</td>
<td>102</td>
</tr>
<tr>
<td>BA</td>
<td>61</td>
<td>126</td>
<td>68</td>
<td>123</td>
</tr>
<tr>
<td>JAL</td>
<td>-14</td>
<td>123</td>
<td>-10</td>
<td>130</td>
</tr>
</tbody>
</table>

*a* Other airlines flying to Australia (at 30.6.80) but not included are Air Nauru, Air New Zealand, Air Pacific, Alitalia, Cathay Pacific, JAL, KLM, Lufthansa, Merpati, PAL, SAA, UTA, but see Table 8.4.

*b* Distance (percentage) from own cost frontier.

*c* Cost of providing Qantas output at Qantas fuel price but own wages, relative to Qantas' costs.
TABLE 8.4: Airline Efficiency and Costs of Qantas's Service (%) (UN Wage)

<table>
<thead>
<tr>
<th>Airline(^{a})</th>
<th>1978 (^{b})</th>
<th>1978 (^{c})</th>
<th>1979 (^{b})</th>
<th>1979 (^{c})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laker</td>
<td>-34</td>
<td>49</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>KAL</td>
<td>n.a.</td>
<td>n.a.</td>
<td>88</td>
<td>65</td>
</tr>
<tr>
<td>CPAir</td>
<td>-24</td>
<td>80</td>
<td>-27</td>
<td>76</td>
</tr>
<tr>
<td>Continental</td>
<td>-19</td>
<td>92</td>
<td>-9</td>
<td>95</td>
</tr>
<tr>
<td>Air NZ</td>
<td>26</td>
<td>98</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Pan Am</td>
<td>-12</td>
<td>101</td>
<td>-7</td>
<td>98</td>
</tr>
<tr>
<td>Alitalia</td>
<td>62</td>
<td>107</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>JAL</td>
<td>8</td>
<td>122</td>
<td>16</td>
<td>127</td>
</tr>
<tr>
<td>BA</td>
<td>76</td>
<td>131</td>
<td>66</td>
<td>126</td>
</tr>
<tr>
<td>Lufthansa</td>
<td>31</td>
<td>135</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

\(^{a,b,c}\): See Table 8.3
APPENDIX to Chapter 8 : DATA SOURCES

(1) Variable Cost (CV)

The source for this item was ICAO, Financial data, 1978 and 1979. Labour variable cost was defined as the sum of ICAO cost items:

5.1 Flight crew salaries and expenses
6 Maintenance and overhaul
8.2 En route facility charges
8.3 Station expenses
9 Passenger services
10 Ticketing sales
11 General
12 Other

Fuel variable cost was 5.2 Aircraft fuel and oil so excluded items, presumed to correspond to the fixed factor, were:

5.3 Flight equipment insurance
5.4 Rental of flight equipment
5.5 Flight crew training
5.6 Other flight expenses
7 Depreciation
8.1 Landing fees and airport charges.

Two years' data were included and the raw data had to be deflated to real, thus comparable, terms. The procedure was to convert the raw data (in SUS) to local currency in 1979 dollars (using the ICAO exchange rate for 1979), deflate by the inflation rate in 1979 (from IMF data) then convert to SUS using the 1978 exchange rates. The same deflation was applied to the wage and fuel price variables.
(2) TKP (Y)

This figure was tonne-kilometres performed by all operations reported in ICAO, Financial Data.

(3) Passenger-freight mix (PF)

This variable was calculated as the ratio of passenger tonne-kilometres performed on scheduled services to TKP on all services, which includes freight and mail as well as non-scheduled flights. Source of the raw data was ICAO, Financial Data.

(4) Load factor (L)

This variable was calculated as the ratio of Y and available tonne kilometres for all services. Source of the raw data was ICAO, Financial Data.

(5) Number of aircraft (N)

(6) Average aircraft capacity (A)

(7) Average stage length (E)

(8) Total departures (D)

(9) DC10 proportion (DC)

These variables were all formed from data found in ICAO, Fleet - Personnel. Aircraft capacity was measured in tonnes of average maximum take-off weight. Average stage length was the ratio of total revenue kilometres and total revenue departures (D). DC was the proportion of total capacity in DC10 aircraft.

(10) Price of labour

Two labour price variables were formed, one using the average wage in manufacturing in the country of interest (from UN, Bulletin of Statistics) and the other the average wage paid to ticketing, sales and other promotional personnel from ICAO, Fleet-Personnel. The two variables gave very similar results but
sample sizes differed (the ICAO wage equations had a sample size of 94 compared to the UN wage equations with a sample size of 76).

(11) Fuel price

An ICAO circular (Regional Differences in Fares, Rates and Costs for International Air Transport, 1978) reported prices paid for fuel by route group. Airlines in the sample were allocated to these route groups using descriptions of their operations in Flight International of July 26, 1980. The fuel prices estimated (typically averages) were then used as the fuel price variable for 1978. In 1979, the structure of fuel prices between airlines was assumed to be the same but prices were raised by a factor of 1.51, a measure of the change in a fuel price index reported in the Petroleum Times.

(12) Ownership dummy (DO).

Ownership data were obtained from Flight International, July 26, 1980.
CHAPTER 9: THE COST OF REGULATION

9.1 INTRODUCTION

This chapter combines the results of previous chapters to estimate the cost of regulation. According to the results of Chapters 3 and 4, the competitive solution will be optimal in conditions likely to apply on international routes. The welfare cost occurs because of the difference between the competitive outcome and that of regulation. The model used to estimate the consumption cost of regulation is described in the next section. The characteristics of this model are based on results from Chapter 5. The following section shows how the cost function estimate reported in Chapter 7 can be used to predict the change in the full price of travel in the move from regulation to competition. Then the consumer valuation of this price change is calculated. Before this estimate of the consumption cost of regulation can be regarded as the welfare cost a number of adjustments should be made and some qualifications noted. These are discussed in the final sections of this chapter. In the next chapter, the results are applied in discussion of policy options.

9.2 MODEL OF REGULATION

In this chapter, the following assumptions are made;

(i) Constant returns to scale

This assumption is consistent with the results of the literature reviewed in Section 6.2. One exception is the result of scale economies obtained by Caves, Christensen and Tretheway
the model used here refers to one route so that the unit cost of output could fall, because expansion is occurring within an existing network. However, this interpretation of Caves et al was a conjecture rather than a result. Another exception is the cost function estimated reported in Chapter 8, but as pointed out in that chapter, the estimate was limited to variable costs and the scale economy result could be consistent with constant returns when all factors were variable. If, contrary to the assumption, there were scale economies, the welfare cost would be understated by the method used in this chapter. In the presence of scale economies, the market result would be that of competition, as argued in Chapter 6, but the competitive result would be sub-optimal.

(ii) Carriers with different unit costs continue to operate

This assumption means that countries do not take advantage of the opportunities for revenue pooling. Reasons for this attitude to pooling were offered in Chapter 5 (Section 5.6) and evidence on the variation in costs of different carriers was presented in Chapter 8. Another implication of this assumption, as explained in Chapter 5, is that shares of revenue and frequency will correspond. Total frequency will be determined by a weighted average of the costs of the two end-point-country carriers, where the weights correspond to shares of frequency.

(iii) Zero mark-up on the optimal toll

This assumption implies that both countries act as if they have utility functions in which consumer and producer interests are equally weighted. An alternative would be to assume that producer
interests have a higher relative weight which would have led to a positive mark-up. Hence the implication is that the welfare cost estimated here will be a lower bound.

In summary, countries use their power over landing rights to control entry to their routes. Subsequently they negotiate fares and frequencies with the country at the other end of each route. Total frequency is set by a criterion involving a weighted average of the costs of the end-point-country carriers. The money fare is equal to the optimal toll given the choice of frequency. The entry barriers prevent the regulated carriers being undercut and regulation imposes a welfare cost.

9.3 THE CONSUMPTION COST OF REGULATION

9.3.1 Definition

The model of regulation used here is depicted in Figure 9.1. In that diagram, D is the full price demand curve where the full price \( P^* \) is the sum of the money fare \( P \) and the cost of delay \( d \). Each consumer has identical evaluation of delay. The delay function is homogeneous of degree zero in total trips \( T \) and flight frequency \( F \) and can be written \( d = d(T/F) \). In Figure 9.1, the short run (fixed frequency) average cost curve corresponding to the weighted average of the costs of capacity of the end-point-country carriers is marked A. 'Costs' now refer to the sum of delay and the costs of capacity (see Chapter 2). The short run average cost curve of the least cost carrier (which could be, but need not be, one of the end-point-country carriers) for the same frequency is
Passenger Trips

Figure 9.1 Consumption Cost of Regulation
marked A'. The regulated solution is at B, where the regulated full price is $P^*_r$ and the total number of passenger trips is Q. The competitive solution will be at point K where the full price of travel is determined by the costs of the least cost operator. $A''$ is the average cost curve of the least cost operator at optimal frequency. The points K and C lie on the long run (variable frequency) cost curve, which is horizontal since it is assumed that the delay function is homogeneous of degree zero. In summary, B is the outcome of regulation and K is the competitive solution, and the effect of regulation is to raise the full price of travel by $(P^*_r - P^*_c)$.

A measure of the effect on consumer welfare of a price change is the compensating variation (CV), which can be interpreted as the amount a consumer would be willing to pay to bring about the change. The CV can be measured as the area bounded by the price axis, the compensated full price demand curve passing through the initial full price and the old and new full prices. To illustrate measures of the CV in Figure 9.1, D would have to be regarded as the compensated demand curve. In that case, the consumption cost of regulation is the area JBKH.

The change in the full price depends on both the change in the money fare and the value of the change in service quality. To illustrate this point, the full fare under regulation is BQ, in

1 The minimum of A' lies below and to the left of that of A. The reason is that both curves have the same marginal cost curve (M), which is derived from the average delay curve (V) and which must pass through the minima of the A curves.

2 This measure of consumer welfare is discussed by Willig (1976).
Figure 9.1, made up of a money fare of BE and a cost of delay of EQ. In competition, the full fare is equal to GQ, made up of a money fare of GF (equal to KM) and a cost of delay of FQ (equal to MT_k). The difference between the full fares (BG) is
\[ BG = BF - FG = (BE - FG) + EF \]
where (BE - FG) is the fall in the money fare and EF is the decrease in the cost of delay. The method used here is to estimate these components of the change in the full fare and combine them to estimate the consumption cost of regulation.

Before describing the estimates of the change in the full fare, the assumptions made in the model of international regulation can be highlighted by comparing it with models of U.S. regulation. There are differing views of the characteristics of U.S. domestic regulation. Keeler (1972) and Douglas and Miller (1974) found that the money fares in regulation had been set above the level that would maximise consumer benefits (but that any rents created had been competed away by scheduling competition). On the other hand, De Vany (1975) found that the price had been set at the output maximising level, which would be Pareto optimal in competitive markets and would minimise the welfare loss in monopoly markets.1 Olson and Trapani (1981) have synthesised and further distinguished these models. They compared the money fares which will maximise capacity, maximise output and maximise profit in competitive and monopoly markets. (This distinction between market structure is

---

1 A criticism of De Vany (1975) is that his conclusions are based on econometrically estimated parameters none of which is significantly different from zero. All these U.S. models presume the zero profit result is optimal.
necessary because the response to a given money price will vary according to structure.) Olson and Trapani thus distinguish two private interest groups, producers of aircraft and producers of air transport services. They conclude the money price was set to serve the interests of the former group in the early part of the 'seventies and more recently, but prior to deregulation, to serve the interests of the latter group. (They also argue that rents may not have been competed away by scheduling competition when prices were set to serve air transport producers.)

In contrast, the model used here presumes that the regulators have set a fare that serves the interests of consumers, given the cost level regulators use as their target. Because of barriers to entry, that target cost level exceeds the minimum attainable and subsequently regulation imposes a welfare cost. Therefore the model used here ignores pricing designed to further the interests of producers and, to the extent these interests are reflected in pricing, the welfare cost estimate will be biased downwards.

The regulators in the model face an exacting task of duplicating a market mechanism. The difficulty of this task, and the criticism of the views of the regulators made in Chapter 4, suggest that regulatory error is highly likely. A number of types of regulatory error could be imagined. For example, given the cost level used by the regulators, frequency could be set too high or too

---

1 The regulators actually control both fares and frequency and reasons why this is the case are discussed in the next chapter. This question arises because the U.S. literature emphasises that once a money fare is set, the nature of competition determines flight frequency. This point is illustrated in Chapter 10.
low. In the former case, the money fare set could be the break even level (more likely than the optimal toll since the latter would generate negative profit at the target cost level). When frequency is too low, the fare could be imagined at the break-even level or at the optimal toll. In all three cases, the full fare will be higher than necessary, given the cost level used to choose frequency.\footnote{1} Throughout this chapter, an assumption of regulatory perfection is maintained. The implication is that, given the likelihood of error, the welfare cost estimate will be a lower bound to the true figure.

Another distinguishing feature of the model of regulation used here is that the quality of service increases with deregulation. The reason is that deregulation reduces the cost per flight and the benefits are taken out as higher service quality and subsequently lower money fare. In other models of regulation, service quality could fall with deregulation. This is the case in models of U.S. domestic regulation, where rents created have been competed away by frequency competition (Pustay, 1978). The original attempt by the author to estimate the cost of regulation (Findlay, 1978) assumed that service quality would fall with de-regulation. The result was obtained by assuming that the load factor would be higher in competition, which is inconsistent with the model used here.\footnote{2}

Apart from Findlay (1978), another attempt to measure the welfare cost of regulation of international carriers in that of

\footnote{1} This result can be illustrated diagrammatically in a diagram like Figure 9.1.

\footnote{2} In the same paper it was assumed that frequency delay fell with deregulation, which is inconsistent with the argument of Chapter 4.
Barnekov (1978). He estimated 'competitive' fares by examining low-fares proposed for the US domestic and international routes; for example, his sample included Laker proposals for US-UK routes. This was the method used in Findlay (1978), though Barnekov's sample of low-fare proposals is much larger and he estimated competitive fares for different route lengths. Barnekov argued that service quality (in terms of delay) would be less under regulation because the higher fares he observed would have led to reduced frequency, which is the mechanism emphasised in this Chapter. Barnekov only evaluated the gain to consumers of the change in the money fare, also the case here.

9.3.2 Change in the money fare

The method of estimating the change in the money fare is, first, to show that, in Figure 9.1, the same money fare is optimal at point C as at K and then to calculate the change in the money fare in the move from B to C.

In this model it is assumed that the delay function is homogeneous of degree zero which means delay depends on the load factor. In that case the same toll will be appropriate at C and at K if the load factor is the same at those two places. This can be shown as follows. The optimal toll is $T_dT$ which at C is

$$T_C \cdot d'(T_C/F_C)/F_C$$

since $d_T = d'/F$ and where $F_C$ is the frequency at C. The optimal toll at K is

$$T_K \cdot d'(T_K/F_K)/F_K$$

which will be the same as the toll at C if the $T/F$ ratios are the same, in other words, if the load factors are the same. (In this model aircraft size is fixed.)
The problem is now to show that the load factor is the same at the competitive full fare \( P^*_c \), along the line HH, whatever the number of passenger trips. The competitive full fare can also be interpreted as the long run average cost. Denote total cost by \( R \), then

\[
R = kF + Td(T/F)
\]

and at \( P^*_c \),

\[
R_F = \frac{\partial R}{\partial F} = k + Td_F = 0,
\]

where \( T \) is fixed

If the load factor is constant along the HH line, then

\[
\frac{dF}{dT} = \frac{F}{T}
\]

but

\[
\frac{dF}{dT} = -\frac{R_{FT}}{R_{FF}} \quad \text{(from the condition, } R_F = 0)\]

where

\[
R_{FT} = -2Td'/F^2 - T^2d''/F^3
\]

and

\[
R_{FF} = 2T^2d'/F^3 + T^3d''/F^4
\]

so

\[
\frac{dF}{dT} = \frac{F}{T}
\]

Hence the load factor is constant along HH, and the same money fare is optimal at C as at K.

Since the optimal money fares are equal at C and K, the fall in the money fare in the move from B to K can be estimated by comparing the money fares at B and C. Points B and C have a number of characteristics in common; total frequency is the same, average cost is minimised and revenue from the optimal toll covers the cost of the flights at both points. The difference is that cost per flight is less at C than at B. These characteristics can be used to estimate the change in the money fare.
Average cost \((A)\) is defined as
\[
A = d + \frac{kF}{T}
\]
At point B, average cost is minimised so
\[
A_T = d_T - \frac{kF}{T^2} = 0
\]
where \(F\) is held constant while \(T\) is varied. The next question is what is the effect on optimal \(T\) of a change in \(k\) (cost per flight), given \(F\)? In this case,
\[
\frac{dT}{dk} = -\frac{A_{Tk}}{A_{TT}}
\]
where
\[
A_{TT} = d_{TT} + 2kFT^{-3} > 0
\]
\[
A_{Tk} = -\frac{F}{T^2} < 0
\]
so
\[
\frac{dT}{dk} = \frac{(F/T^2)}{(d_{TT} + 2kFT^{-3})}
\]
For simplicity it is assumed that \(d_{TT} = 0\) so
\[
\frac{dT}{dk} = \frac{T}{2k}
\]
which overstates \(dT/dk\) since \(d_{TT}\) is positive. This derivative is the rate at which \(T\) is changing for a change in \(k\), at the given values of \(T\) and \(k\). This rate is then used to estimate the change in \(T\) for a non-marginal change in \(k\). Since
\[
\frac{d^2T}{dk^2} = \frac{(T/2k)[(1/2k)-1]} < 0
\]
which means that \(dT/dk\) is falling as \(k\) increases (or rising as \(k\) falls), the change in \(T\) for a large change in \(k\) will be understated by this method (this error is in the opposite direction to that introduced earlier by letting \(d_{TT} = 0\)).

At B, toll revenue equals the total cost of frequency so
\[
PQ = kF
\]
where \(P\) is the money fare at \(B\). Also at \(C\),
\[
(P - \Delta P)(Q - \Delta Q) = (k - \Delta k)F
\]
but

\[ \Delta Q = \left( \frac{Q}{2k} \right) \Delta k \]

then it can be shown that

\[ \Delta P/P = \frac{1}{2(k/\Delta k) - 1} \]

where all changes are defined in absolute terms.

The only data needed to estimate the percentage change in the money fare are the figures for the percentage change in cost per flight. In the model of regulation used here

\[ k = c k^H + (1-c) k^O \]

where \( H \) refers to the home country and \( c \) to its share of frequency and \( O \) refers to the other country. Let \( k' \) be the cost per flight in competition then

\[ \Delta k = k - k' = c(k^H - k') + (1-c)(k^O - k') \]

and

\[ \Delta k/k = c(1 - k'/k^H)k^H/k + (1-c)(1 - k'/k^O)(k^O/k^H)(k^H/k) \]

The problem is then to estimate the ratios \( k'/k^H \), \( k^H/k \), \( k'/k^O \) and \( k^O/k^H \). Now

\[ k/k^H = c + (1-c)k^O/k^H \]

so

\[ (k^O/k^H)(k^H/k) = \frac{1}{1 + c/(k^O/k^H) - c} \]

Also

\[ k'/k^O = (k'/k^H)(k^O/k^H) \]

In summary, the data required are the ratios \( k'/k^H \) and \( k^O/k^H \) (these ratios can be obtained from the estimates of the cost function) as well as estimates of \( c \), the home country carrier's share of frequency and revenue. These estimates, and the corresponding estimates of \( \Delta P/P \), are reported in Table 9.1, for the
thirteen routes for which data were available from the cost function estimates of Chapter 8.

9.3.3 Change in the cost of delay

Delay here depends only on the load factor which at B is

\[ L_B = \frac{Q}{mF_C} \]

Assuming m is fixed in the transition to competition,\(^1\) the load factor at K (and at C) is

\[ L_K = \frac{(Q - \Delta Q)}{mF_C} \]

but

\[ \Delta Q = (Q/2k)\Delta k \]

so

\[ L_K = \left(\frac{1}{mF_C}\right)(Q - (Q/2k)\Delta k) \]

then

\[ L_K = L_B \left(1 - \frac{\Delta k}{2k}\right) \]

so

\[ L_B - L_K = \left(L_B/2\right)(\Delta k/k) \]

This estimate of the change in the load factor can be used in the Douglas and Miller (1974) formula for stochastic delay to estimate its effect on the probability of having to wait. The results are reported in Table 9.2. In most cases, at current load factors, the probability of having to wait is already very small and the effect of the drop in the load factor has only a small effect,

---

\(^1\) It is possible that, as the number of passengers on a route increases in the move to competition, it becomes optimal to increase aircraft size. The effect on the components of the full fare is uncertain but the full fare must either be the same or less, since the constraint of fixed aircraft size has been removed. Again, the implication is that the estimate of the welfare gain will be conservative.
TABLE 9.1: Estimates of Change in Money Fares

<table>
<thead>
<tr>
<th>Route: Australia to</th>
<th>( c(1) )</th>
<th>( \frac{0}{k}H(2) )</th>
<th>([\Delta k/k]_C(3))</th>
<th>([\Delta k/k]_V(3))</th>
<th>( \Delta P/P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>.56</td>
<td>1.27</td>
<td>.47</td>
<td>.33</td>
<td>.20</td>
</tr>
<tr>
<td>Thailand</td>
<td>.50</td>
<td>.62</td>
<td>.26</td>
<td>.18</td>
<td>.10</td>
</tr>
<tr>
<td>Malaysia</td>
<td>.50</td>
<td>.62</td>
<td>.26</td>
<td>.18</td>
<td>.10</td>
</tr>
<tr>
<td>Canada</td>
<td>.50</td>
<td>.74</td>
<td>.34</td>
<td>.24</td>
<td>.14</td>
</tr>
<tr>
<td>Indonesia</td>
<td>.46</td>
<td>.75</td>
<td>.31</td>
<td>.22</td>
<td>.12</td>
</tr>
<tr>
<td>Singapore</td>
<td>.50</td>
<td>.81</td>
<td>.34</td>
<td>.24</td>
<td>.14</td>
</tr>
<tr>
<td>USA</td>
<td>.38</td>
<td>.98</td>
<td>.39</td>
<td>.27</td>
<td>.16</td>
</tr>
<tr>
<td>India</td>
<td>.50</td>
<td>.90</td>
<td>.37</td>
<td>.26</td>
<td>.15</td>
</tr>
<tr>
<td>PNG</td>
<td>.45</td>
<td>.94</td>
<td>.38</td>
<td>.27</td>
<td>.16</td>
</tr>
<tr>
<td>Japan</td>
<td>.48</td>
<td>1.26</td>
<td>.47</td>
<td>.33</td>
<td>.20</td>
</tr>
<tr>
<td>NZ</td>
<td>.52</td>
<td>.98</td>
<td>.40</td>
<td>.28</td>
<td>.16</td>
</tr>
<tr>
<td>Italy</td>
<td>.41</td>
<td>1.07</td>
<td>.43</td>
<td>.30</td>
<td>.18</td>
</tr>
<tr>
<td>Germany</td>
<td>.46</td>
<td>1.35</td>
<td>.50</td>
<td>.35</td>
<td>.21</td>
</tr>
</tbody>
</table>

NOTES TO TABLE 9.1

1. The share of the home country carrier (Qantas) was estimated by that carrier's share in the sum of capacity provided by itself and the flag carrier or carriers of the country at the other end of the route. Capacity data were obtained from Department of Transport, Australia, Air Transport Statistics, International Air Transport, 1979, and from a list of aircraft capacities provided by Transport Australia. In some cases, where the country was served 'en route' to others, \( c \) was assumed to be 50%. The reasonableness of this assumption was checked using scheduled capacity in timetables provided by Transport Australia.

2. Variable costs of firms on the frontier (\( k' \)) and those of other firms (\( k^0 \)) relative to Qantas costs (\( k_H \)) were obtained from the cost function estimates. The ratio \( k'/k_H \) was assumed to be 0.60 (see Chapter 8).

3. The cost function estimates only refer to variable costs. Examination of firms used in the sample, in 1978, showed that on average variable costs were 70% of the sum of total operating costs reported by ICAO plus 20% (an upper bound estimate of Qantas' cost of capital reported in the Appendix to Chapter 9) of the book value of assets (to reflect capital costs). The change in variable cost was then scaled down by this factor to estimate the change in total cost per flight.
of three percentage points or less. But in two cases this is not so (on routes to PNG and to Canada). The reason is these routes are characterised by loads at the top of the range; also aircraft sizes on these routes are relatively small, which in the Douglas and Miller formula, at the same initial load factor raises the probability of having to wait, and raises the gain from a reduction in the load.

Generally, the data in Table 9.2 indicate that, with two exceptions, the gains from reduction in load factors are likely to be small relative to the change in the money fare. Therefore the gains from the improvement in service quality following deregulation are ignored in the calculation of the cost of regulation.

9.3.4 Consumer evaluation

The consumption cost of regulation is the area JBKH in Figure 9.1. An expression for this area is

$$W = (\Delta P^*)Q + (\Delta P^*)^2s/2$$

where $P^*$ refers to the full price of travel and $s$ is the slope of the full price compensated demand curve. Here the change in $P^*$ is

---

1 To illustrate this point, let time be valued at $6.12 per hour, the gross non-managerial wage used in Chapter 4, and assume $I$ is 24 hours (flights are one day apart). Then, a change of 3% points in the probability of having to wait would be valued at $4.41, small compared to the change in the money fare. For lengths of wait longer than 24 hours, $6.12 would exceed the appropriate value of time, given people can reorganise their activities; this point was discussed in more detail in Chapter 4. The same load factor was also assumed to apply to all travellers. To the extent effective rationing devices are available, the value of the reduction in load factor will be even less. A final comment on the small sizes of the change in the cost of delay relative to that of the money fare is that there is no inconsistency, since the former depends on average delay and the latter on marginal delay.
### TABLE 9.2: Estimates of Change in Probability of Delay

<table>
<thead>
<tr>
<th>Route: Australia to</th>
<th>$\Delta k/k$ (1)</th>
<th>$L^R/L^C$ (2)</th>
<th>$b^R/b^C$ (3)</th>
<th>$L^R/L^E$ (2)</th>
<th>$b^R/b^C$ (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>.33</td>
<td>.66/.55</td>
<td>.05/.03</td>
<td>.63/.53</td>
<td>.05/.03</td>
</tr>
<tr>
<td>Thailand</td>
<td>.18</td>
<td>.53/.48</td>
<td>.05/.04</td>
<td>.49/.45</td>
<td>.04/.03</td>
</tr>
<tr>
<td>Malaysia</td>
<td>.18</td>
<td>.44/.40</td>
<td>.03/.03</td>
<td>.33/.30</td>
<td>.02/.02</td>
</tr>
<tr>
<td>Canada</td>
<td>.24</td>
<td>.72/.63</td>
<td>.18/.11</td>
<td>.73/.64</td>
<td>.19/.11</td>
</tr>
<tr>
<td>Indonesia</td>
<td>.22</td>
<td>.51/.45</td>
<td>.03/.03</td>
<td>.56/.50</td>
<td>.04/.03</td>
</tr>
<tr>
<td>Singapore</td>
<td>.24</td>
<td>.62/.55</td>
<td>.06/.04</td>
<td>.64/.56</td>
<td>.07/.05</td>
</tr>
<tr>
<td>USA</td>
<td>.27</td>
<td>.64/.55</td>
<td>.05/.03</td>
<td>.66/.57</td>
<td>.07/.04</td>
</tr>
<tr>
<td>India</td>
<td>.26</td>
<td>.63/.55</td>
<td>.05/.03</td>
<td>.66/.57</td>
<td>.05/.03</td>
</tr>
<tr>
<td>PNG</td>
<td>.27</td>
<td>.63/.54</td>
<td>.14/.09</td>
<td>.64/.55</td>
<td>.16/.11</td>
</tr>
<tr>
<td>Japan</td>
<td>.33</td>
<td>.38/.32</td>
<td>.02/.01</td>
<td>.42/.35</td>
<td>.02/.02</td>
</tr>
<tr>
<td>NZ</td>
<td>.28</td>
<td>.63/.54</td>
<td>.06/.04</td>
<td>.61/.52</td>
<td>.06/.04</td>
</tr>
<tr>
<td>Italy</td>
<td>.30</td>
<td>.63/.53</td>
<td>.04/.03</td>
<td>.51/.43</td>
<td>.02/.02</td>
</tr>
<tr>
<td>Germany</td>
<td>.35</td>
<td>.56/.46</td>
<td>.03/.02</td>
<td>.58/.48</td>
<td>.04/.03</td>
</tr>
</tbody>
</table>

### NOTES TO TABLE 9.2

1. The estimate of the change in cost per flight is taken from Table 9.1.

2. L refers to load factor, the R superscript refers to regulation and the C superscript to competition. I refers to inbound flights and E to outbound flights. Thus $L^R_I$ is the load factor under regulation on an inbound flight. Load factors were calculated using capacity data provided by the Department of Transport Australia (see note 1, Table 9.1). Load factors are a weighted average of loads on Qantas flights and those of the flag carrier of the country at the other end of the route. Exceptions occur when Qantas serves the city 'en route' to others, in which case L refers to the load on the flag carrier of the other country.

3. Only stochastic delay is considered here. The Douglas and Miller (1974) estimate of the stochastic delay function is used to estimate the effect of the change, in the load factor on the probability of having to wait. Their formula is, for expected average delay in minutes

$$Ts = 0.455 \left( N_f/\sigma_f \right)^{-0.645} \left( (S-N_f)/\sigma_f \right)^{-1.79} I$$
NOTES (Cont.)

where

\[ \begin{align*}
N_f &= \text{mean flight demand} \\
\sigma_f &= \text{standard deviation of flight demand} \\
S &= \text{flight capacity} \\
I &= \text{interval between flights}
\end{align*} \]

which can be written as

\[ Ts = 0.455 \left( \frac{N_f}{\sigma_f} \right)^{-0.645} \left( \frac{S}{\sigma_f} \right)^{-1.79} (1-L)^{-1.79} I \]

or

\[ Ts = b.I \]

Then values of \( b \) were calculated for different load factors and these are reported in the Table. Their interpretation is, for example, in the case of inbound flights from the UK, that when the load factor falls from 66% to 55% with deregulation, the probability of having to wait drops from 5% to 3%.
assumed equal to the change in the money fare, since the value of the decrease in the cost of delay is ignored. This means that, if the full price compensated demand function is \( T = T(P+d) \), \( P \) is varying but \( d \) is held constant. The money fare elasticity of demand is then \( e = T'P/T \), (where \( P \) and \( T \) are both measured at point \( B \) in Figure 1) then substituting for \( s \) (which equals \( T' \))

\[
W = \Delta P \cdot Q\left[1 + \frac{\Delta P}{P}(e/2)\right]
\]

The terms in this expression can be measured although the largest problem is to measure the elasticity. One aspect of this problem is that actual elasticity estimates may not correspond to the estimates required. The reason is that the actual estimates could include a congestion effect when \( d \) is not held constant. To illustrate this point, define \( e_a \) as

\[
e_a = \frac{(dT/dP)P}{T}
\]

where

\[
dT/dP = T'(1 + dT(dT/dP))
\]

so

\[
dT/dP = \frac{T'/(1 - T'dT)}{1}
\]

which is less than \( T' \) in absolute terms. If the actual estimates correspond to \( e_a \), the elasticity will have been understated. But

---

1 It should be emphasised that only the money fare elasticity of demand is being substituted into the expression for the welfare cost. This is appropriate when the price change estimated is the change in the money fare. If this price change were converted to the change in the full fare, the full fare elasticity should be used in the formula. The result will be the same, since the full fare elasticity will be higher than the money fare elasticity (at the same \( T' \) and \( T \)) but the percentage change in the price variable would be less. The money price version of the formula is used here because it corresponds to the data available. In the formula, both the price change and the elasticity are defined in absolute terms.
if $d_T$ is small, as argued in the previous section, the error may not be great.

Another aspect of the problem of measuring the elasticity is that $e$ should be the compensated elasticity, which is estimated by subtracting from the (absolute value of the) actual elasticity the product of the budget share of the commodity and its income elasticity. Some evidence of the budget share of air travel for non-business travel is available for Australian residents from the Household Expenditure Survey.¹ The proportion of the household budget spent on holidays (which includes holiday fares, petrol and accommodation in Australia and overseas) is only 3.6% for the highest income group in the survey (for whom this share is greatest). Assume the income elasticity of demand is at most 4 then the adjustment to the price elasticity, to obtain the compensated elasticity, will be at most 0.14. Given the small size of this adjustment, and the low degree of confidence with which the elasticity estimates are held (see below), it was decided to use a range of elasticity estimates, appropriate for the trip purpose and direction of travel, and assume they correspond to the compensated elasticities. The range of elasticity figures used, suggested by the studies reviewed² in Findlay (1981c), are listed in Table 9.3.

Some comments are required on the method used to estimate the money fare paid under regulation. The method was to use data on the proportion of travellers by trip purpose by ticket type to

¹ Australian Bureau of Statistics, Household Expenditure Survey, 1975-76, Cat. No.6507.0

TABLE 9.3: Range of Price Elasticity Estimates

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>RESIDENTS</th>
<th>VISITORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Business (Bus)</td>
<td>-1.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>Holiday (Hol)</td>
<td>-1.0</td>
<td>-0.5</td>
</tr>
<tr>
<td>Visiting Friends</td>
<td>-1.0</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

and Relatives (VFR)
calculate a weighted average fare for each group (residents and visitors by trip purpose). The estimated change in money fare was applied to this weighted average to estimate \( \Delta P \). The implication was that the weights would stay the same before and after regulation and that all fares would change by the same proportion. The money fare calculated was the return fare so the welfare cost estimated here refers to a trip in both directions. (An alternative would have been to calculate the cost for a one way trip and double the estimate but the final answer would have been the same.) Finally, it was assumed that the fare paid was that set by regulation and that the fare was the same in both directions; since the extent of discounting varies between countries, and is expected to be lower in Australia than elsewhere, this assumption will tend to overstate the consumption cost.\(^1\) In the calculation, seasonal fares were averaged, fares used were from Sydney to the major destination in each country (Vancouver and Los Angeles for Canada and the US respectively) and costs of booking conditions were ignored (implying no change).

Elasticities vary according to trip purpose and whether the travellers are residents of Australia or foreign visitors. Also fares paid vary between trip purpose. Therefore the consumption cost is calculated for each route and for each classification of traveller. The results, in per capita terms and in total are shown in Table 9.4.

\(^1\) Another reason for fares varying between direction is that the airlines may not use market exchange rates when converting between currencies, under IATA pricing mechanisms. See Forsyth (1980) for an example on the Australia-Japan route where fares were higher from Japan than from Australia.
The results are summarised in Table 9.5. The total annual cost on routes listed in Table 9.4 is $211.22m but these routes do not account for all traffic. The method of accounting for other routes is to inflate the total figure according to the proportion of total traffic accounted for by routes in Table 9.4. When this adjustment is made, the total cost is $280.81m. Trip data used so far excluded permanent and long term movement. These travellers are assumed to travel only one way so the consumption cost is estimated as the product of the total number of trips of this type and half the average cost per trip of $148. With this addition, the annual total consumption cost on routes to Australia is estimated to be of the order of $300m.

9.4 ADJUSTMENTS AND QUALIFICATIONS

9.4.1 Loss to Australian consumers

One adjustment which can be made to the measure of the consumption cost follows from the observation that not all consumers are Australian, and taking a parochial view, losses by foreigners would not be counted. To illustrate this point, divide consumers into two groups, Australian (A) and others (O). In Figure 9.2, $D_A$ is the full price demand curve of Australians and the horizontal sum of $D_A$ and the foreign curve corresponds to $D$ in Figure 9.2 (and 9.1). The total consumption cost is $JBKH$ which is the sum of the cost to Australians of $JCDH$ and the rest ($CBKD$) but only the area $JCDH$ is relevant for parochial Australian cost-benefit analysis. The cost to Australian consumers can be estimated using the results reported in Table 9.5; the cost to short term travellers who were
# TABLE 9.4: Consumption Cost by Route and Type of Traveller

1979 ($A)(1)

<table>
<thead>
<tr>
<th>Route Purpose</th>
<th>Residents Departing</th>
<th>Visitors Arriving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bus</td>
<td>VFR</td>
</tr>
<tr>
<td>UK (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>328</td>
<td>250</td>
</tr>
<tr>
<td>T</td>
<td>6.16</td>
<td>18.04</td>
</tr>
<tr>
<td>Thailand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>105</td>
<td>79</td>
</tr>
<tr>
<td>T</td>
<td>.202</td>
<td>.056</td>
</tr>
<tr>
<td>Malaysia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>89</td>
<td>66</td>
</tr>
<tr>
<td>T</td>
<td>.383</td>
<td>.226</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>155</td>
<td>124</td>
</tr>
<tr>
<td>T</td>
<td>.245</td>
<td>.499</td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>94</td>
<td>70</td>
</tr>
<tr>
<td>T</td>
<td>.484</td>
<td>.095</td>
</tr>
<tr>
<td>S'pore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>126</td>
<td>103</td>
</tr>
<tr>
<td>T</td>
<td>1.127</td>
<td>.260</td>
</tr>
<tr>
<td>Route Purpose</td>
<td>Residents Departing</td>
<td>(4)</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Bus</td>
<td>VFR</td>
</tr>
<tr>
<td>USA</td>
<td>P</td>
<td>192/200</td>
</tr>
<tr>
<td>India</td>
<td>P</td>
<td>178/185</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>.261</td>
</tr>
<tr>
<td>PNG</td>
<td>P</td>
<td>76/79</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>.678</td>
</tr>
<tr>
<td>Japan</td>
<td>P</td>
<td>323/339</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>1.752</td>
</tr>
<tr>
<td>NZ</td>
<td>P</td>
<td>52/54</td>
</tr>
<tr>
<td>Italy</td>
<td>P</td>
<td>259/270</td>
</tr>
<tr>
<td>Germany</td>
<td>P</td>
<td>374/392</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>1.643</td>
</tr>
</tbody>
</table>
NOTES TO TABLE 9.4

1. The units of measurement vary between rows of the table. The P rows refer to the per trip welfare cost, measured in dollars. The T rows refer to total cost, measured in millions of dollars.

2. The per trip cost is calculated for the low and high elasticity figures reported in Table 9.3.

3. The total cost figure (the per trip cost multiplied by the number of trips of that category) is calculated for the lower elasticity figure.

4. Total refers to the total cost over all short term trips. This figure is more than the sum of the three components in the rows because there is another category of traveller, called "other", listed in the Australian Bureau of Statistics source of data on trip numbers. The total is then the sum of the three types listed but inflated according to the proportion of 'other' trips in the total. 'In transit' passengers were ignored. Also the total trip data includes sea travellers but they account for 2% or less of the total and no correction was made.
TABLE 9.5  Consumption Cost (CC), 1979

<table>
<thead>
<tr>
<th>Description</th>
<th>Residents</th>
<th>Visitors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Total CC from Table 4</td>
<td>$117.75m</td>
<td>$93.47m</td>
<td>$211.22m</td>
</tr>
<tr>
<td>(ii) Total Short-Term trips on Table 4 Routes</td>
<td>820,476</td>
<td>604,155</td>
<td></td>
</tr>
<tr>
<td>(iii) Cost Per Trip</td>
<td>$143</td>
<td>$155</td>
<td>$148</td>
</tr>
<tr>
<td>(iv) Total Short-Term Trips - all Routes</td>
<td>1,175,769</td>
<td>725,006</td>
<td></td>
</tr>
<tr>
<td>(v) Total Cost on Short Term Trips - all Routes</td>
<td>$168.21m</td>
<td>$112.60m</td>
<td>$280.81m</td>
</tr>
<tr>
<td>(vi) Number of Long Term and Permanent Trips - all Routes</td>
<td></td>
<td></td>
<td>265,235</td>
</tr>
<tr>
<td>(vii) Estimated Cost on Type (vi) Trips (1)</td>
<td></td>
<td></td>
<td>$19.6m</td>
</tr>
<tr>
<td>(viii) Total Cost</td>
<td></td>
<td></td>
<td>$300.41m</td>
</tr>
</tbody>
</table>

(1) Item (vi) multiplied by ($148/2).
Figure 9.2 Cost to Australian Consumers
residents was $168m, and assuming all long term and permanent
travellers are counted as Australian, the consumption cost born by
Australians is approximately $188m, or about 63% of the total cost.

9.4.2 Rents to factor owners

Another adjustment to the consumption cost, in order to
reach an estimate of the welfare cost, is that some of the consumer
surplus lost may be received as a transfer by owners of factors of
production. The transfer should be subtracted from the consumption
cost. If a parochial view is taken only rents accruing to domestic
factor owners should be counted. This observation was emphasised in
Chapter 5; for example, the loss of Australian consumer surplus
(JCDH) could be exceeded by the rents earned by the flag carrier
Qantas and this possibility was suggested as a motive for
regulation. In Figure 9.2, the potential rents available are JBLH.
Qantas carries approximately 45% of total traffic entering and
leaving Australia. 1 Potential rents available to Qantas are then
45% of JBLH, marked as the area JFHG. Since Australian consumers
lose 63% of JBKH due to regulation, it is not possible that rents
earned by Qantas could offset that loss.

The rents available were described as 'potential' since
Qantas is not a minimum cost operator (according to the results of
Chapter 8). Hence some of the area JFGH will be absorbed as

1 Department of Transport, Australia, Air Transport Statistics,
International Air Transport, 1979. The gap between the
traffic carried by Qantas and the proportion of Australian
travellers in the total is due in part to fifth and sixth
freedom carriage of traffic.
production cost. The extent of this cost can be estimated by examining Qantas' profitability.

Qantas' profitability is examined in detail in the Appendix to this chapter. The results are not held with high confidence, but Qantas earned (at best) zero economic profits over the period 1973-74 - 1979-80. The implication is that the whole of the potential rent available to Qantas appears to have been absorbed as a production cost of regulation.

A qualification to this result is that although the owners of Qantas capital (the taxpayers) have not received super-normal returns, it is possible that other factor owners have earned rents. An estimate of the extent of these rents is the difference between Qantas costs and those of a frontier carrier purchasing Australian factors of production in competitive markets. In Chapter 8 it was estimated that Qantas variable costs were approximately 29% above its frontier. Assuming variable costs are 70% of total costs, a shift to the frontier is estimated to lower Qantas' variable costs by 23% and its total costs by 16%. The weighted average change in money price from Table 9.1 is 17% (where the weights used were total trips on each route). In Figure 9.2, the distance JH is therefore 17% of the average money fare. Adopting the zero economic profit result for Qantas, the average money fare under regulation is approximately the same as Qantas unit cost. Thus a 16% fall in total cost for Qantas is represented by about 94% of the area JFHG.

1 This result is consistent with those of Chapter 8, where it was shown Qantas was not the high cost carrier on all routes but was so on a majority of routes. In the model of regulation used here, the high cost carrier on a route always earns negative economic profit on that route.
This area (not drawn to scale) is marked as JFNR in Figure 9.2. The balance (area RNHG) is interpreted as the true production cost of regulation.

To summarise the results so far, the regulated price was estimated to fall about 17% with deregulation. At the regulated price, Qantas earned zero profit but it was estimated that if Qantas could move to its frontier its total costs would fall by about 16%. It seems that in a competitive environment Qantas could nearly break even. However this estimate is optimistic because it will be recalled that the least cost operators (60% of Qantas variable costs) had inefficiencies of their own included in that cost figure. Deregulation would presumably remove those extra costs as well so Qantas, it is expected, would have more difficulty than illustrated in continuing to earn at least zero economic profit. Another implication is that, just as the estimate of the price fall in deregulation is conservative, so will be the estimate of the true production cost of regulation.

The next question is whether the area JFNR is a deadweight cost or a transfer. According to the model of Chapter 7 some part will be a transfer to owners of factors employed in Qantas. But part will also be a loss because of the restriction on choice. The extent of this cost is difficult to estimate so area JFNR must be interpreted as an upper bound to the transfer.\(^1\)

---

1 Another reason for regarding this area as an upper bound estimate of the transfer is that the presence of rents is expected to encourage competition to obtain those rents (Posner, 1975). In the Posner model of rent seeking, all the potential rents will be absorbed by costs of seeking them so the whole of JFNR would be a deadweight cost. See Grenning (1981) for discussion of the behaviour of rent-seekers who are not risk neutral.
9.4.3 Other adjustments

A number of other aspects of the cost of regulation have been ignored in this calculation of the welfare cost.

The first is that the current fare structure is unnecessarily discriminatory. Examples of the types of tickets available were reported in Chapter 2. It is expected that in competition a variety of ticket types would be available but they would vary in the quality of service offered. In particular they could be differentiated by the probability of getting a seat, as well as the standard of cabin service or seating space. Prices of these tickets would be related to cost. Current ticket types which are differentiated by an advance purchase period or length of stay condition cannot be interpreted this way.\(^1\) They are simply devices for drafting consumers into groups and effectively extracting surplus from them. To the extent these conditions still impose deadweight costs on consumers, as emphasised by the Bureau of Transport Economics (BTE, 1978), their removal would lead to further welfare gains.

A second cost of regulation could be that of inefficient network structures. For example, as described in Chapter 4, Australian regulators appeared to have the view that capacity should be determined by the numbers of true origin and destination traffic. This view led to the emphasis on a point-to-point regime. But such a pattern of traffic could reduce the opportunities for

\(^1\) To illustrate, advance purchase fares cannot be interpreted as equivalent to standby tickets because there appears to be a fixed quota of such tickets on each flight and purchasers of these tickets are still guaranteed a seat on a particular flight.
reducing costs by directing traffic through regional hubs, as described in Chapter 4.

A third adjustment is due to the assumption that fares are the same in both directions on a route both before and after deregulation. After deregulation, prices could vary between directions depending on the imbalance in traffic and the ability of airlines to shift capacity. Thus fares could fall by different proportions in each direction.

These types of loss from regulation have been ignored here implying once again that the welfare cost estimate will be a lower bound to the true figure.

9.5 SUMMARY

The consumption cost of regulation on routes to Australia was estimated to be approximately $300m, of which about $168m was borne by Australian residents. It is not possible that this loss by Australians could be offset by rents earned by Qantas, because Qantas market share is less than the share of residents in total trips. In recent years, Qantas appears to have earned (at best) zero economic profit, so rents have not accrued to the owners of capital. Other factor owners may have earned rents.
APPENDIX TO CHAPTER 9: QANTAS COST OF CAPITAL AND PROFITABILITY

A9.1 INTRODUCTION

In this Appendix the presence of Qantas in the list of potential public sector projects is taken as given, decided by some criterion other than the cost of capital and rate of return discussed below. In that case, the methods of cost-benefit analysis of public sector projects (Marglin, 1963) can be applied to the problem of measuring Qantas' profitability. The Qantas project could be characterised as an initial investment of (say) $K while each period $v are paid to the firm by its customers, reflecting the value of Qantas' commercial services. The externality benefits that are claimed for Qantas are assumed to be valued at $x each year. The government must finance the initial investment. By doing so it is assumed to displace, in raising a dollar, $a of private sector investment and $(1-a) of consumption. The social value of the dollar of private sector investment is $p/r, where $p is the private sector rate of return and $r is the social rate of time preference; the former exceeds the latter because of the presence of taxation. Under these conditions, the criterion for the Qantas project is that (assuming continuous discounting and an infinite time period, for simplicity):

\[ \int_{0}^{\infty} xe^{-rt} dt + \int_{0}^{\infty} ve^{-rt} dt \geq [a(p/r) + (1-a)]K \]

which can be simplified to

\[ (x+v)/K \geq (1-a)r + ap \]

The interpretation of this expression is that the rate at which benefits are generated must exceed a weighted average of the
private sector rate of return and the social time preference rate, where the weights are the proportions in which investment and consumption are displaced by government finance.

In the calculation that follows, the externality benefits claimed will be ignored so the profitability estimate refers only to Qantas' commercial activities. Questions in the application of the criterion are, first, how to determine the weights (a and (1-a)) and secondly, how to treat risk when Qantas is part of the public sector.

The weights may depend on how the finance is raised. Since these weights are not clear, the simplest approach is to use both p and r, and interpret them as upper and lower limits to the true value. The second question was discussed in Chapter 6, where it was concluded there was no case for differential treatment of government investment in aviation, on grounds of government attitude to risk.

The next problem is to estimate the two measures of the cost of funds (p and r). An estimate of p is the cost of capital Qantas would face if it were privately owned. Such a rate will include a risk premium, which is appropriate because investment in the Qantas project imposes risk on taxpayers.1

One complication might be that Qantas borrows, to finance many of its assets, on international capital markets. But it would be wrong to say that Qantas' cost of funds is the rate it pays on these funds, borrowed with government guarantee. The reason is that the shareholders (here the taxpayers) bear all the risk, no matter

---

1 If the Arrow and Lind (1970) model applied, it could be argued that the appropriate private sector rate to use here was the rate of return in the absence of the risk premium (See Boadway (1979, pp.202-203)). But it was argued above that the Arrow and Lind conditions were not relevant.
how small is their equity. As argued above, the cost of risk bearing should be incorporated in the target rate of return. In other words, the target rate of return should reflect the costs of debt and equity.

It is possible that investment in Qantas will displace only consumption, in which case the social time preference rate is the appropriate rate to use. However, the taxpayers still bear a risk and a premium should also be added to that rate to obtain the target rate of return. Here this risk adjusted social time preference rate will be measured by the after-tax rate of return on equity, invested in a project of similar risk.

A9.2 METHOD

The cost of funds to a private sector firm before tax is given by (Officer, 1981, p.9)

\[ k_0 = \frac{k_e}{1-t} \frac{S}{V} + k_d \frac{D}{V} \]

where
- \( k_0 \) = before tax cost of capital
- \( k_e \) = cost of equity
- \( k_d \) = cost of debt
- \( S \) = value of equity
- \( D \) = value of debt
- \( V = S + D \) = value of the firm
- \( t \) = company tax rate.

The cost of equity is given by the capital asset pricing model as (Officer, 1981, p.21)
\[ k_e = k_f + B[E(k_m) - k_f] \]

where \( E(k_m) \) = expected return to a market portfolio
\( k_f \) = risk free rate
\( B \) = relative (or systematic) risk of equity.

In summary, the data required to estimate \( k_o \) and \( k_e \) are
(a) debt/equity ratio
(b) cost of debt \( (k_d) \)
(c) risk free rate \( (k_f) \)
(d) systematic risk \( (B) \)
(e) market rate \( (E(k_m)) \)
(f) company tax rate.

(a) Debt/Equity Ratio

According to book values Qantas' shareholders' equity is only about 9% of total asset value. Recently Qantas' management have used this figure to argue to the government for an increase in paid up capital and the government responded by subscribing an extra $25m.1 The motive was to ease the 'burden' of interest payments. Qantas had requested a much greater subscription from its owners (the taxpayers) of $100m with the aim of raising equity to 40% of assets. However when assets are revalued using market prices, which is attempted below, shareholder equity is already this proportion of the total asset value. Qantas management are reported as claiming the 40-60 equity to debt ratio as typical of the 'average' Australian company. In this Appendix, this ratio is retained as an estimate of the ratio of equity to debt.

1 Australian Financial Review, 20 November 1981, p.15
(b) Cost of Debt

Two values for the cost of debt were used. The first was obtained by dividing Qantas' interest payments by the reported value of debt. This figure, of about 5%, was interpreted as an estimate of Qantas' actual cost of debt, a figure which is not shown in the annual reports.

The other figure for the cost of debt was an estimate of the cost without government guarantee. This was approximated by the rate paid on 5 year debentures by finance companies associated with trading banks of 11.0% (the geometric average over the period 1973-1980).\(^1\) The rationale for using this figure would be that other items are estimated using market data which may not reflect the extra risk borne by the owners (the taxpayers) in this case because of the government guarantee to debtholders, a guarantee which may not be offered by shareholders in private companies. If the higher figure were not used, the cost of capital would be understated.

(c) Risk Free Rate

The risk free rate is estimated as the geometric average rate on ten year government bonds over the period 1973-1980 of 9.62\%.\(^2\)

---


2 Ibid. Strictly, this asset cannot be regarded as risk free because the inflation rate is not known with certainty. The rate could be understated because of the tax subsidy via the 30/20 rule.
(d) Relative Risk of Equity

Since shares in air transport companies are either not traded or represent claims on highly diversified companies, it is not possible to estimate a value for $B$ from Australian data; Foster (1978) reports an air transport industry average (equity) beta of 1.8 for the period 1966-1974, a period of regulation in the US.\(^1\) This value indicates the return to investment in air transport is highly positively correlated with the market return (that is, with a portfolio of average riskiness which has a beta of 1.0). Officer (1981, p.29) notes beta estimates may not be reliable and also comments that the 95% confidence intervals of 'most' company's estimates of beta would include 1.0. It was therefore decided to use 2 values of beta, 1.8 and 1.0 to be interpreted as upper and lower bounds to the true value.

(e) Market Rate

Swan (1981) estimated the rate of return on the market portfolio over the period 1959-1981 to be 14.2%. Also over this

---

\(^1\) Brealey and Myers (1981) report an asset beta for the airline industry of 0.75. This beta differs from the equity beta used in the text because the asset beta has had the effect of financial leverage removed. The relationship between the asset beta ($B_A$), the debt beta ($B_D$), and the equity beta ($B$) is

$$B_A = B(S/V) + B_D (D/V)$$

which can be solved for $S/V$ as

$$S/V = (B_A - B_D)/(B-B_D)$$

If debt is riskless, its beta is zero, then using the beta estimates reported above, the $S/V$ ratio estimated is 0.42. If debt is risky, the $S/V$ ratio will be less. These estimates of $S/V$ are very close to the estimates of actual $S/V$ for Qantas, which implies the beta value of 1.8 is appropriate for Qantas.
period the average bond rate was 6.85% while over the period of interest here this bond rate average was 9.62%, or 2.8% higher. Therefore, it was decided to use 17% (14.2% + 2.8%) as the market rate of return for the period of interest here.

(f) Company Tax Rate

As Officer (1981) points out, the tax rate used should be the effective tax rate, which need not equal the prescribed rate. For example, capital gains, which are included below in the definition of the return to equity, will be tax free. The depreciation rates used below are less than the rates used in Qantas' annual reports so, for this reason also, the prescribed tax rate of 46% will overstate the effective rate. It is possible to estimate the effect of higher depreciation rates, for calculation of taxable income, on the effective tax rate. The rate used by Qantas in its annual reports (for B707 aircraft) is approximately 9% while the true rate is estimated below to be 6%. The effective company tax rate is then estimated to be lowered from 46% (nominal rate) to 35%.1 This rate may still overstate the effective rate because it ignores the presence of tax free capital gains. It is evident from the definition of the cost of equity that a higher tax rate raises the cost of capital. Since the prescribed rate overstates the effective rate, an extreme approach would be to ignore the tax rate. The result would be a conservative estimate of the cost of capital.

---

1 Let \( t \) be the effective rate and \( m \) be the nominal tax rate then \( t = m \frac{I^T}{I} \) where \( I^T \) is taxable income and \( I \) is true income. This relationship can be manipulated to \( t = m\left(1 + \frac{(e - e^T)K}{I}\right) \) where \( e \) is the true depreciation rate \( e^T \) is the rate for tax purposes and \( K \) is the capital stock. The assumption of \( I/K = 12\% \) (see below) gives the result in the text.
capital. This approach adopted here is to calculate the cost of capital using effective tax rates of zero and 35% and to regard estimates based on the latter rate as the upper limit.

A9.3 PROFITABILITY CRITERIA

This information can now be combined to estimate Qantas' before tax cost of capital, in nominal terms, if it were part of the private sector. The results are shown in Table A9.1; the cost of capital ranges from 10-16 percent (on the assumption of a zero company tax rate) or 14-21 percent with a 35% effective tax rate. This latter range of rates is regarded as the private sector rate of return, to be interpreted as the upper limit to correct rate by which to evaluate Qantas profitability. The lower limit is estimated by the after-tax rate of return on equity in Qantas; applying a marginal personal income tax rate of 46%, the estimates of the lower bound range from 9 to 12 percent.

A9.4 QANTAS' RATE OF RETURN

Data on the value of the Qantas enterprise and its profitability are reported in Table A9.2. Before discussing the results, methods of estimating some items should be noted.

(i) Value of debt, equity and assets.

Assets were valued at a combination of market and book values, debt at book value and equity as the difference between asset and debt values.

1 The U.S. Civil Aeronautics Board (CAB) uses 17% as the cost of capital in its calculations of the standard foreign fare level (see U.S. CAB, Standard Foreign Fare Level Investigation, Dockets 37730 and 37744, August 12, 1980 and U.S. CAB (1980)).
TABLE A9.1: Qantas' Cost of Capital if Privately Owned

<table>
<thead>
<tr>
<th>Beta</th>
<th>$k_e^{(a)}$</th>
<th>Effective tax</th>
<th>$k_d$</th>
<th>$k_o^{(b)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>17.0</td>
<td>0</td>
<td>5.0</td>
<td>9.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.0</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>0.35</td>
<td></td>
<td>5.0</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.0</td>
<td>17.1</td>
</tr>
<tr>
<td>1.8</td>
<td>22.9</td>
<td>0</td>
<td>5.0</td>
<td>12.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.0</td>
<td>15.8</td>
</tr>
<tr>
<td></td>
<td>0.35</td>
<td></td>
<td>5.0</td>
<td>17.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11.0</td>
<td>20.7</td>
</tr>
</tbody>
</table>

Notes: 
(a) $k_e = k_f + B(k_m - k_f)$
$k_f = 9.6$
$k_m = 17.0$

(b) $k_o = \left[k_e/(1-t)\right](S/V) + k_d[1-(S/V)]$
$S/V = 0.4$
The aim in using market values was to avoid understating the value of total assets by relying on book values. But market values were available only for aircraft, which accounted for between 58 and 68 per cent of the estimated value of assets. Other assets were valued at book values so the value of total assets could still be understated.

The method of valuing fleet, which included B707/338C and B747 aircraft, was to obtain market values either from surpluses earned from the sale of B707's combined with an estimate of their book values at the time of sale, or from purchase prices of new B747's paid by Qantas with an allowance for depreciation.

Depreciation rates used were estimated from Qantas' experience with B707's. New B747 prices were used to form a price index for aircraft. The index was used to deflate market values of used B707's then real B707 prices were compared to estimate the true depreciation rate (of 6% as opposed to the rate used for 707 aircraft of about 9%).

Land and buildings were included at book value. Excluded was the book value of the Qantas Centre in Sydney, currently under construction. The correct treatment of this asset, for this exercise, would be to include the building at the time of completion, valued at the construction cost plus interest costs during construction; at that time, the book value can be adjusted for any loss in value, for which provision currently is made.

Other assets included were plant and motor vehicles and current assets (at book value). Aircraft spares were excluded since it was expected they were included already in the aircraft values. Finally, investments in other companies were excluded so the asset value refers to airline operations alone.
Debt was valued at the reported book value, which has been adjusted for exchange gains and losses.\(^1\) Most Qantas borrowings are at fixed rates of interest and as rates vary, the market value of the debt will vary. No attempt has been made to calculate this market value but over the decade of interest, interest rates have been rising, implying falling debt values so the value of debt is likely to be overstated.

(ii) Airline Revenue

Airline revenue is the total revenue figure reported in the accounts less income from subsidiaries.

(iii) Expenditure

Expenditure-R (R for reported) refers to reported expenditure less interest and depreciation, the latter as reported in the accounts. True depreciation, calculated as the change in market value of existing fleet over the year plus reported depreciation for other assets, is added to this figure to obtain true expenditure (-T).

A comment on the depreciation estimates is that they are negative in some years, particularly the later years of the period when rising new aircraft prices have offset the effects of use on value. The exception is 1978/79; the explanation is that in this year, the index of new B747 prices changed very little from the previous year but rose by a large amount in the following year (1979/80). These changes seem implausible and could reflect a deal

\(^1\) Debt excludes the value of loans drawn to finance construction of Qantas Centre.
made by Qantas and Boeing, its supplier of aircraft. If so, the rise in prices of new aircraft would have been more gradual. The effect would be to lower depreciation in 1978/79 and raise it the following year. The implication of this problem is that the average return over the period will be more reliable than figures for individual years.

(iv) Airline Profit

Airline profit is airline revenue minus true expenditure.

(v) Exchange Losses

These data are the change in value of debt in $A due to exchange rate changes in the relevant year; they differ from the amounts brought into the accounts by Qantas (a smaller amount).

(vi) Return to Equity

Return to equity is airline profit less exchange losses and less interest, not including estimated interest paid on loans for Qantas Centre construction (estimated as 5% of loan drawn).

(vii) Rates of Return

The rates in Table A9.2 are calculated by averaging the opening and closing values of the relevant base. For example, the rate of return on funds of 8.7% in 1973/74 is calculated as airline profit that year divided by the average value of assets. The ratio interest/debt is calculated as total interest on the total value of debt (including Qantas Centre loans).
The geometric average rate of return on total funds employed in Qantas, over the period 1973/74 - 1979/80 is estimated to 11.8% (from Table A9.2). The rate of return criteria estimated in section A9.3 were an upper limit in the range 14-21 percent and a lower limit in the range 9-12 percent. Qantas performance over the period of interest falls in the lower range, which was interpreted as an estimate of the social time preference rate. Qantas performance would not satisfy the criteria applied in the private sector unless the effective tax rate were zero and the beta value for equity were unity (see Table A9.1). In summary, Qantas appears to have earned at best zero economic profit over the period 1972-73 to 1979-80 and could have earned large negative profits over that period.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of Debt</td>
<td>190.3</td>
<td>189.8</td>
<td>214.4</td>
<td>266.3</td>
<td>318.7</td>
<td>433.1</td>
<td>478.4</td>
<td>663.6</td>
</tr>
<tr>
<td>Value of Equity</td>
<td>147.5</td>
<td>153.7</td>
<td>153.2</td>
<td>147.6</td>
<td>162.5</td>
<td>225.7</td>
<td>193.4</td>
<td>274.8</td>
</tr>
<tr>
<td>Value of Assets</td>
<td>337.8</td>
<td>343.5</td>
<td>367.6</td>
<td>413.9</td>
<td>481.2</td>
<td>658.8</td>
<td>671.6</td>
<td>938.4</td>
</tr>
<tr>
<td>Airline Revenue</td>
<td>247.7</td>
<td>310.6</td>
<td>398.8</td>
<td>471.6</td>
<td>566.9</td>
<td>648.7</td>
<td>743.6</td>
<td>921.0</td>
</tr>
<tr>
<td>Expenditure - R</td>
<td>219.0</td>
<td>267.4</td>
<td>371.0</td>
<td>451.4</td>
<td>507.4</td>
<td>577.9</td>
<td>658.7</td>
<td>826.1</td>
</tr>
<tr>
<td>Depreciation</td>
<td>10.0</td>
<td>13.6</td>
<td>13.9</td>
<td>8.4</td>
<td>-17.1</td>
<td>-52.0</td>
<td>29.7</td>
<td>-78.2</td>
</tr>
<tr>
<td>Expenditure - T</td>
<td>229.0</td>
<td>281.0</td>
<td>384.9</td>
<td>459.8</td>
<td>490.3</td>
<td>525.9</td>
<td>688.4</td>
<td>747.9</td>
</tr>
<tr>
<td>Airline Profit</td>
<td>18.7</td>
<td>29.6</td>
<td>13.9</td>
<td>11.8</td>
<td>76.6</td>
<td>122.8</td>
<td>55.2</td>
<td>173.1</td>
</tr>
<tr>
<td>Exchange Losses</td>
<td>-20.8</td>
<td>-3.3</td>
<td>14.3</td>
<td>11.0</td>
<td>22.3</td>
<td>19.6</td>
<td>16.6</td>
<td>-0.3</td>
</tr>
<tr>
<td>Interest (Net)</td>
<td>8.9</td>
<td>8.4</td>
<td>8.9</td>
<td>10.5</td>
<td>13.9</td>
<td>17.9</td>
<td>23.8</td>
<td>25.9</td>
</tr>
<tr>
<td>Return to Equity</td>
<td>30.6</td>
<td>24.5</td>
<td>-9.3</td>
<td>-9.7</td>
<td>40.4</td>
<td>85.3</td>
<td>14.8</td>
<td>147.5</td>
</tr>
<tr>
<td>Rates (%)</td>
<td>Interest/Debt</td>
<td>4.4</td>
<td>4.5</td>
<td>4.4</td>
<td>4.8</td>
<td>4.8</td>
<td>5.0</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Airline Profit/Assets</td>
<td>8.7</td>
<td>3.9</td>
<td>3.0</td>
<td>17.1</td>
<td>21.5</td>
<td>8.3</td>
<td>21.5</td>
</tr>
<tr>
<td></td>
<td>Return to Equity/Equity</td>
<td>16.3</td>
<td>-6.1</td>
<td>-6.6</td>
<td>24.9</td>
<td>37.8</td>
<td>7.7</td>
<td>53.7</td>
</tr>
</tbody>
</table>
CHAPTER 10: POLICY OPTIONS AND SUMMARY

10.1 INTRODUCTION

In this chapter, a number of policy options are compared. Some can be implemented within the existing regulatory structure while others require major institutional changes. While these options are examined, the opportunity is taken to summarise the results of previous chapters. Thus this final chapter serves as both a review of policy options and of the work of the thesis. The options considered are:

(i) sale of the flag carrier
(ii) deregulation of capacity
(iii) deregulation of fares
(iv) deregulation of both fares and capacity (or 'Open Skies')

10.2 SALE OF THE FLAG CARRIER

Since 1947 the Australian flag carrier Qantas has been wholly owned by the government. The proposal examined in this section is that Qantas be sold to private shareholders. No other change in the regulatory environment is envisaged.

The effects of moving from public to private ownership in a regulated environment were discussed in Section 7.2.5. The predictions were that the change in type of ownership would lead to a redistribution of the rents available toward owners and away from

---

1 Parts of this chapter appear in Findlay (1981b).
managers and would remove any deadweight cost due to the restriction on managerial choice. An implication of the first effect is that the costs of government owned firms will generally be higher than those of privately owned firms and this effect was observed in the cost function estimate reported in Chapter 8.

Results from Chapter 8 were that Qantas lay above the cost function of an 'average' privately owned firm by a distance equal to the predicted effect of government ownership and that it, subsequently, lay even further above its frontier (see Figure 8.1). Sale of Qantas would then be expected to shift the firm toward the frontier. Positive profits could subsequently be earned by Qantas under regulation. But the firm could still appear to be technically inefficient, depending on the type of contract made with management (and other factor suppliers), their taste in perks and their share of the rents. Regulation would still incur a production cost because, according to the estimates in Chapters 8 and 9, Qantas' private ownership cost frontier lies above the minimum cost level of firms that would dominate the market in competition.

In summary, the main effect of sale of Qantas is expected to be redistributive. Greater profits would be earned by the owners and less rents received by other factor suppliers. The only effect on the deadweight cost of regulation would be the removal of restrictions on managerial choice.

Depending on how the sale is organised, the profits need not be retained by the new owners. At an auction, the expected present value of profits would be passed to taxpayers as a lump sum. On the other hand, some administrative mechanism might be used, such as granting access to foreign routes to the privately
owned domestic trunk carrier (Ansett). In that case, potential profit could be dissipated by rent seeking behaviour. Finally the switch to private ownership could affect the rents earned by owners of factors other than capital and management but the effect is difficult to predict without an explicit bargaining model.

10.3 DEREGULATION OF CAPACITY

The policy envisaged is removal of capacity control but maintaining control of money fares. The effect of this policy can be illustrated in Figure 10.1 (based on Figure 9.1). Let point H be the regulated solution where both price and capacity are controlled (the short run average full cost curve is not shown). Now relax controls on capacity but assume in the first instance that entry is restricted to the two flag carriers on the end point country carriers. For simplicity it is assumed they have equal costs per flight. Consistent with the characteristics of the delay function applicable to international routes, their long run cost curve is the horizontal line through points B and H. If the money fare is not altered then total capacity will not change when it is deregulated. But say the money fare is raised from HE to AC then expansion of capacity will be profitable. Frequency will increase until an equilibrium is reached at point A where profits are zero again (along short run average full cost curve AR).

A modification of this policy is to permit free entry. In that case, if point A were reached by the designated carriers, carriers with even lower cost would find further expansion of capacity profitable. While the money fare is fixed, the load factor
Figure 10.1 Deregulation of Capacity
would fall even further and eventually only the lowest cost operators would survive.\textsuperscript{1}

Figure 10.1 can be used to discuss the welfare implications of deregulation of capacity. There are two versions of the policy to examine, one where entry is free and one where it is restricted. In the former case, only the low cost operators will survive. It is evident that if the regulators set the correct price, regulation will simply duplicate the optimum. But it is likely that regulators will make an error. To illustrate the effect of regulatory error in this case assume that, in Figure 10.1, the cost curve marked $A_R$ is now one of a series for the lowest cost operators. Then the optimal solution will be at point $H$. If the regulators make an error and set the money fare, not at its optimal $H_E$, but at $AC$, then capacity will expand and the solution will be point $A$, where frequency will be excessive.

Another version of the policy of deregulation of capacity is one in which entry is controlled. It is also assumed that both designated carriers have the same costs since, if this were not the case, the low cost carrier would provide all flights, as a result of the competitive process. The result is that, in the absence of regulatory error in the previous policy where both fares and capacity are controlled, deregulation of capacity alone will have no effect. Reasons why regulators then want to have control of both fares and capacity, while they have control of entry, are discussed below.

\textsuperscript{1} This process of frequency competition is assumed to be competitive and to lead to zero profit. This is more likely in the case of free entry. See Douglas and Miller (1974), De Vany (1975) and Panzar (1979a) for models of frequency competition in the presence of restrictions on entry.
The characteristics of this option of deregulating capacity but not fares can be highlighted by using the model to discuss the effects of US domestic regulation, which has been examined by Keeler (1972), Douglas and Miller (1974), De Vany (1975) and Olson and Trapani (1981). As reported earlier, all these authors except De Vany argue that regulation had led to fares that were too high. In terms of Figure 10.1, this pricing policy can be modelled as setting a money fare like AC instead of the optimal HE. In some cases (Keeler, and Douglas and Miller) it was argued that rents created were competed away by frequency competition, since frequency had not been effectively controlled by regulation. In terms of Figure 10.1, the solution would then be point A. In another case (Olson and Trapani), it was argued that the money fares had been set at the capacity maximising level; in terms of Figure 10.1, the money fare would then have been set so that the short run (or fixed frequency) average cost curve would have been tangential to the full price demand curve. In all these cases, airlines would have earned zero profit.\footnote{These papers also discuss pricing rules in monopoly markets but attention is restricted here to the competitive results. Olson and Trapani argue that in some years, even in otherwise competitive markets, regulation has acted as a cartel manager so both the money fare and capacity were set at monopoly profit maximising levels. This solution could also be illustrated in a diagram like Figure 10.1.}

Regulation, of the US type, imposes a welfare cost because the money fare is excessive. In contrast, the model used here predicts a welfare cost because the target cost level used by regulators exceeds the minimum possible. It is generally assumed here that the regulators set the optimal money fare, but the
analysis also recognises that the regulators could make an error. The model used here takes the average cost levels as given and uses them to determine frequency and the full fare. In the US models, the total costs of the carriers are determined, in competitive markets, by the money fare set. In other words, frequency competition raises total costs so that profits are dissipated. In summary, there are significant differences between the regulatory process envisaged here and that which characterises US domestic markets. If the option of deregulating capacity were introduced, Australian international policy could take on US characteristics if the regulators make an error in their choice of money fare.

10.4 DEREGULATION OF FARES

This policy envisages deregulation of both retail and wholesale fares but maintaining control of capacity of individual carriers. 1

The effect of fares deregulation on welfare can be estimated by presuming that at the cost level previously used as the target under regulation, the regulators had chosen an optimal frequency and toll. In other words, given capacity, they were pricing so that trips occurred where the marginal cost curve cut the full price demand curve. This price will be the same price as

---

1 Another option would have been to control wholesale fares but deregulate retail fares. This policy would ensure competition in the retail sector, presuming large numbers of retailers who cannot coordinate their pricing, which could lead to gains for both consumers and airlines if retailers currently have market power. However this policy would have had little effect on the policy expected to be the major source of welfare cost, the regulation of international carriers.
competitive profit maximisers will choose under the same capacity. (This result was derived in Chapter 3.) Thus removal of price control while fixing capacity will lead to no change.

The regulatory pricing rule described, in the 'public interest' model of Chapter 5, represents losses for some carriers and profits for others. Normally this outcome would lead to expansion of capacity by the lower cost operators who would displace the others. But this response is not possible under the policy of capacity control envisaged here.

Capacity control acts as a barrier to the entry of new firms. Under these conditions the designated carriers may be able to coordinate their actions to maximise joint profits. In that case the mark-up on the optimal toll would be positive, at the monopoly solution (see Chapter 3). The full price of travel would rise and there would be a decrease in welfare. This possibility of monopoly behaviour under restricted entry provides the rationale for control of maximum prices. This appeared to be part of the case for regulation used in the ICAP report, reviewed in Chapter 4.

In summary it is possible that in the absence on control of fares, the designated carriers could act as cartel and maximise profit. But this result depends on effective coordination between them which seems unlikely without the aid of the regulation.

The question is now whether deregulation of fares but not capacity of individual carriers can lead to welfare improvement. When the initial regulatory outcome contains no error, deregulation will have no effect so there will be no change in the welfare cost.

---

1 Although as noted in Chapter 2, the regulations did not strictly give the Department of Transport power over maximum fares.
If the situation before deregulation contained some error then deregulation of fares must lead to a welfare gain. This point can be illustrated by an example. Prior to deregulation of fares, the regulated fare may have exceeded the optimal toll. Then, when fares are deregulated, the money fare will fall and utilisation will become optimal. The full fare will also fall, but need not do so for there to be a welfare gain in these circumstances of regulatory error.

The argument so far is that, in the absence of regulatory error under the current regime of control of fares and capacity, deregulation of fares while not changing capacity of individual carriers will have no welfare effects. If the current regime contains some error, there will be a welfare gain. Australian experience of trying to control capacity, discussed in Chapter 2, suggests a likely direction of error is toward excess capacity. If the money fare had been set at the optimal toll for a level of capacity less than that actually available, the example of the previous paragraph applies and the money fare will fall.

The same downward pressure on money fares occurs under a regime of control of fares and capacity in periods of excess capacity. Examples of the discounting that occurs were discussed in Chapter 2. A falling money fare need not lower profit, even for the higher cost carrier; the reason is the money fare is set by competitive forces at the profit maximising level, given the capacity available. But under the current regulatory regime, discounting in Australia can lower Qantas' profit because it lowers revenue yields on the local flag carrier by attracting the higher fare paying customers to the discounting, and foreign based,
carriers. Thus given the difficulties of controlling capacity and the presence of a discriminatory pricing structure, the Australian regulators have in past preferred to attempt to control both fares and frequency.

Instead of trying to control discounting another regulatory response to excess capacity would be to permit the regulated carrier to match the discounts. The outcome of this process is predicted to be an optimal pricing structure (discussed in Chapter 4). The rationale from the point of view of the flag carrier is that, given the difficulty of avoiding discounting, it can gain from the profit maximising characteristics of a fare structure determined in the market. This response is a characterisation of the most recent policy announced by Australia which corresponds to deregulation of wholesale and retail fares while controlling capacity of individual carriers (see Chapter 2). The discussion of this section indicates such a policy will reduce the welfare cost of the previous regime or at worst, lead to no change.

10.5 OPEN SKIES
10.5.1 Introduction

The argument so far is that the current system of international civil aviation regulation imposes substantial costs on consumers and the community. Deregulation would remove that cost. One expected consequence of deregulation of both fares and frequency is that the designated Australian carrier (Qantas) seems likely to earn negative economic profits. The evidence was that the cost level on the frontier faced by Qantas, given Australian factor prices, exceeded the estimated level of competitive money fares.
Thus if there is a legitimate public interest motive for having a national flag carrier, the government would have to sustain Qantas' losses.

Externality motives for intervention were reviewed in Chapter 6. It was not always clear there were valid arguments for intervention in the civil aviation sector. But for the sake of completeness it is assumed in the rest of this Chapter that there is some valid externality argument for intervention.

Apart from sustaining its losses, the government could continue to protect Qantas within the existing regulatory regime. Three adjustments to that regime were examined in previous sections of this Chapter. While continuing to protect Qantas, none of these options would involve relaxation of entry conditions. Without that change the welfare gains they could generate are expected to be small.

The policy now examined is expected to lead to much greater welfare gains. This policy is a combination of open skies, including relaxation of entry barriers, with explicit subsidies, where necessary.

The characteristics of the competitive solution were examined in detail in Chapters 3 and 4 and the welfare gains from moving to competition were estimated in Chapter 9. In the rest of this chapter attention is concentrated on the operation of a subsidy policy within 'open skies'. The next section discusses the subsidy equivalent to regulation and then the operation of the subsidy is outlined. Some of this discussion is relevant even if there is no case for a subsidy. Examples are the response to the argument that open skies are impossible (see Chapter 5) and discussion of the likelihood of predatory behaviour.
10.5.2 Subsidy Equivalent

In this section it is assumed that the motive of regulation is to achieve a particular flight frequency by the locally based carrier. A policy of competition (or "open skies"), which means no price or capacity control and free entry, will not necessarily allow the designated carrier to sustain this frequency when constrained to break-even. The question is then, by what mechanism can a country ensure its carrier's frequency? In this section, the costs of a subsidy that has equivalent effects to regulation are compared to, and found to be less than, the costs of regulation. Operation of the subsidy scheme is not straightforward and a sketch of how it could work is presented in the next section.

For simplicity it is assumed the carrier of interest (called the "designated" carrier) has the costs of the target carrier of regulation. Of course, this need not be the case but it seems a reasonable approximation for Qantas (by the zero economic profit result of Chapter 9). In this case the production cost of regulation is the area BXWA in Figure 10.2\(^1\) (which is based on Figure 9.2). It is assumed the output target of regulation is the number of flights the designated carrier provides in the regulatory solution. In that case the subsidy budget is equal to the production cost of regulation.

The effect of this subsidy on the number of passenger trips on the designated carrier can be illustrated with the aid of Figure 10.2. In that diagram, A' is the cost curve of the designated carrier.

---

1 In this section the distinction between actual costs and those on the frontier for an Australian based carrier are ignored for simplicity: see Section 10.5.3.2.
Figure 10.2 Regulation and its Subsidy Equivalent
carrier assuming it provided the number of flights which was optimal in competition. A" is the cost curve of the lowest cost operator for the same number of flights. The designated carrier must operate at the same load factor as its competitors but its cost per passenger trip will be higher. The unit subsidy per passenger trip it will require is shown by the distance RF, which exceeds the difference between the competitive and regulated prices (YF) by RY. Therefore the number of passenger trips which the subsidy policy will sustain will be less than the number provided under regulation.

The explanation of this result is that the character of the trips has changed because the load factor is now lower; in other words, trip quality is higher and it will cost more to provide the same number of trips. The subsidy is equivalent to regulation, in terms of passenger trips, in the sense that it could provide the same number of trips as regulation as long as the quality of the trips was the same.

The gain from replacing regulation by its subsidy equivalent can also be illustrated in Figure 10.2. Under the subsidy policy, the only deadweight cost is the production cost of BXWA. The gain from switching to a subsidy is that consumers no longer incur a cost. The net Australian gain is therefore the areas EGS plus XESW (the latter is approximately 15% of the area ABCV, by the Australian data reported above.)

The conclusion of this section is that regulation has a cheaper subsidy equivalent. Before concluding there is a gain from switching to open skies, with subsidies, if necessary, there are other aspects of the subsidy policy which should be examined. These are (1) the cost of financing the subsidy, (2) the method of
disbursement, (3) the claim that unilateral action is impossible and (4) the likelihood of predatory behaviour by subsidised international airlines. The last two items are relevant whether or not an Australian subsidy is envisaged.

10.5.3 Operation of the Subsidy Policy

10.5.3.1 Costs of financing the subsidy

The subsidy may not be costless to raise. For example, when the subsidy is raised through the tax system, the change in tax rates will add to distortions already present. But because this tax is much more broadly based than the commodity tax of regulation, it is expected the extra welfare cost in the tax system will be less than the gain of the consumer deadweight loss triangle in the air transport market. For example, if the subsidy is raised by the income tax system, increased marginal rates will create their own deadweight loss such as a distortion of work-leisure choices. The author and Robert Jones (1982) have estimated the costs of this distortion. Depending on the labour supply elasticity, there is a range of estimates. Using a reasonable elasticity figure, the cost of raising the subsidy is estimated to be 13% of the subsidy.¹ If the latter is 45% of the area ABCV then the cost of financing the subsidy is 10% of ABCV. The gain of replacing regulation by its subsidy equivalent is then still positive but reduced to area EGS plus 5% of area ABCV.

¹ This figure is actually the marginal cost of public funds at current tax rates. If a large amount is to be raised, the cost could be understated.
10.5.3.2 Method of Disbursement

A subsidy for international civil aviation could be disbursed by a bidding system, (see Williamson (1976) for a discussion of these systems), in particular, by recurrent short term contracts. Airlines, restricted to those who can generate the valued externality, would bid amounts of subsidy per flight. This amount if paid would shift the local cost curves (see Figure 10.2) down to those of the lowest cost carriers. The regulators would have to establish the optimum number of flights to subsidise, as implicitly they must under regulation for this purpose. The optimum extent of intervention will depend on the subsidy required, and could be zero. The subsidy could be decided after bids were received. If there were network economies, carriers could bid a schedule of subsidies per flight, which depended on frequency. Otherwise single bids of subsidy per flight would be made. The policy could be applied route-by-route. The number of bids accepted need not be restricted to one; a number of firms could offer the required number of flights. There would be no need to set price and load factors since they would be determined by competition between all carriers on the route. Free entry would apply.

The advantages and disadvantages of this system compared to regulation can now be examined under the headings (suggested by Williamson (1976))

(a) adaptation to changing circumstances;
(b) cost minimisation;
(c) bidder parity at contract renewal time.
(a) Adaptation to changing circumstances -
If a long-term contract is to be made, the terms of the contract may need to be altered as demand or technology changes. Renegotiation could be costly and it has been argued that regulation is a method of facilitating adaptation to these changes (Williamson, 1976, p.91). But recurrent short-term contracting offers the same advantages. For example, there is no need to specify all contingencies in the contract; reactions to changes that actually occur can be made at contract renewal time (Williamson, 1976, p.83).

(b) Cost minimisation -
Under the subsidy policy, carriers can be guaranteed the short-fall between revenue and costs. If this guarantee were made to one firm for a long period, the regulators would have to monitor the costs of the firm to ensure that the subsidy paid was not excessive. The same monitoring problem exists under the current regime. It was predicted in Chapter 7, and supported by the evidence of Chapter 8, that regulation, and government ownership, can raise costs. This result is contrary to the expectations of the early regulators who, as reported in Chapter 2, believed that regulation and public ownership would solve monitoring problems. Competition will keep pressure on firms to minimise costs and, in recurrent short term contracting, carriers are regularly exposed to this pressure. Therefore it is expected that the subsidy required will not be inflated as a result of monitoring problems. Thus a further advantage of the subsidy policy is that it can reduce the cost of intervention by removing any potential rents which have been converted to deadweight cost. For example, competition between
carriers will bid the total subsidy down to area UHWA in Figure 10.2, if BXHU are potential rents to factors of production.

(c) Bidder parity at contract renewal -
There has been some discussion of whether incumbents have advantage at contract renewal time. This is important because, if so, the advantage of the bidding system of minimising costs will be lost. The concern arises because the new firm may incur costs of collecting and installing the physical and human capital required that the incumbent does not face. These costs may not be significant for physical capital if, as Williamson (1976) argues, the investments are relatively unspecialised. This is true for aviation equipment which can be traded in second-hand markets. Human capital may be a problem in a particular route but less important for an established firm. In other words, sunk costs are not significant in air transport (see Chapter 6) and it seems reasonable to assume there would be bidder parity at renewal time, just as it is reasonable to conclude air transport markets are contestable.

The disbursement of the subsidy has not been described in detail but has been developed to a degree sufficient to indicate the policy is feasible.

10.5.3.3 Unilateral Action
The argument so far is that regulation of international civil aviation imposes a cost on the community. Presuming that a country has established it can benefit from externalities, it is argued here that an explicit subsidy could achieve the same result
as regulation but more cheaply. In summary, open skies with explicit subsidies, when required, would allow a country to pursue these interests at minimum cost.

This view is typically criticised by those who argue that an independent policy, characterised as open skies, is not possible and that a cooperative policy, characterised as regulation, is required. This argument was reviewed in Chapter 5. It was concluded there that, on the contrary, the current regulatory regime is actually the outcome of a non-cooperative approach to aviation policy. But it is possible that cooperation is required in international civil aviation policy, for the success of open skies, at least on some routes, and to avoid the ever present tendency to regulate.

It was shown in Chapter 5 that the non-cooperative pursuit of individual gains by unilateral regulation then retaliation, which leads to extensive regulation, can result in both countries being worse off than in competition on the route. The way to avoid this result is for the countries to reach an understanding that neither will pursue its own short run interests by unilaterally regulating. A cooperative policy of this type would be a characteristic of a successful move to competition.

Discussion in this section has emphasised the incentives for unilateral regulation, the mechanism by which this leads to extensive regulation and the value of cooperative agreements in avoiding socially undesirable outcomes. A qualification to this emphasis is that the gains from unilateral regulation will be small if the elasticity of demand on particular route is large. This will be the case where there are a number of routes which are close
substitutes, due to their proximity. Therefore the problems, and the value of cooperative agreements, emphasised here will be greater on routes to relatively isolated destinations.

The assumption is implicit here that competition would be negotiated bilaterally. Questions are whether the policy should or would be negotiated bilaterally? It might be argued competition should be negotiated multilaterally since competition on some routes but not others could lead to inefficient routings of trips by some passengers. But this cost, which may not be significant, would only exist during the adjustment to open skies on all routes.

This observation leads to the answer to the second question: countries on routes which are close substitutes may want to negotiate multilaterally. It might be objected that previous multilateral talks on economic regulation of international air transport have failed to reach agreement (see Chapter 2). But in previous talks the dispute was over pricing and revenue sharing and, applying the model of Chapter 5, disagreement was inevitable. Talks the aim of which was open skies would be concerned with the move to a socially preferred point.

10.5.3.4 Predatory behaviour

Another objection to the subsidy policy could be that countries will subsidise their carriers to drive others from the route. The motive of this predatory behaviour could be to earn future profits. But there will be no incentive to incur losses if future profits are wiped out by free entry.

A final objection to the subsidy policy could be that it could lead to a "subsidy war" which means both countries are
subsidising their carriers more than sufficient to ensure their survival at the competitive price. This outcome appears to be like that of the Prisoners' Dilemma used to characterise regulation in Chapter 5 and so it might be objected that one dilemma is to be replaced by another.

The response to this objection is that there are differences between the subsidy and the regulation. While the result of the subsidy war looks like the Prisoners' problem it is different because it does not require cooperation to be avoided. For example, one country could withdraw unilaterally. Then the subsidy would fall to (marginally below) the level required to guarantee survival at the competitive price, assuming the goal of intervention was either simply survival or some output level less than market output. Alternatively, one country could subsidise by a greater amount than required to achieve these targets. In that case, the other would withdraw and gain from the willingness of the former to provide aviation services at less than the competitive price.

10.5.4 Conclusion

In conclusion, a combination of open skies and subsidies where necessary will allow a country to pursue its legitimate international civil aviation interests but cooperation between countries may be required on isolated routes to avoid the tendency to return to regulation. This package is presented as the cheapest policy.

1 The outcome of the subsidy war may be appropriate, if for example, one country wants to achieve an output target in excess of the competitive level and the other country wants its carrier to operate the route as well.
REFERENCES


Bureau of Transport Economics (BTE) (1978), "Factors Affecting Demand for International Air Travel to and from Australia", Occasional Paper 11, AGPS, Canberra.


Findlay, C.C. (1981c), "Estimates of Price and Time Elasticities of Travel Demand to and from Australia", mimeo., ANU.


Forsyth, P.J. (1981b), "ASEAN and Australia's International Civil Aviation Policy", revised version of a paper given at CCE Conference, Australia and ASEAN in the 1980s, ANU, April.


Forsyth, P.J. (1981d), "Economies of Scale and the Cost of Frequency in Airline Services", paper presented to the Tenth Conference of Economists, ANU, Canberra.


Fysh, H. (1965), Qantas Rising, Angus and Robertson, Sydney.

Fysh, H. (1968), Qantas at War, Angus and Robertson, Sydney.


U.S. Civil Aeronautics Board (CAB) (1980), Costing Methodology - Domestic Fare Structure, Version 6 - Updated, CAB, February.


