From the early days of aviation, air carriers have transported property. Until about five years ago, property transportation other than mail was called “air express” and commanded premium rates. What is presently known as “air freight service” was inaugurated in the latter part of 1944. It is this present air freight service that is generally meant when the term “air cargo” is used. The differences between the present air freight and air express services are not extreme. Essentially, the air express service is intended for the movement of small shipments, and the air freight service is intended for the movement of considerably larger shipments. Twenty-five pounds constitutes approximately the breaking point between the two services. Ground handling for air express is usually somewhat more expedited than for air freight. Once turned over to the airline, both air freight and air express are likely to receive quite similar treatment. The minimum shipment acceptable for air freight is twenty-five pounds, and smaller shipments must still pay for twenty-five pounds. For such a shipment, the air freight rate will be about half the air express rate, but the air express rate will include pick-up and delivery while the air freight rate will apply from airport to airport only. Transportation of freight between city and airport will involve an additional charge of about fifty cents per hundred pounds at each terminal. For bigger shipments, the price difference between air express and air freight is still larger. For shipments of a hundred pounds or more, the rate by air freight may be no more than a third of the rate by air express and is quite often less than one-third.

Air freight service is presently offered by nearly every certificated domestic carrier, including several specialized freight carriers. There is also a very large competitive fringe of small, irregular operators who will haul freight by special arrangement, but who make no attempt to maintain transportation organizations.

The certificate, which is discussed somewhat more fully below, is the certificate of public convenience and necessity issued by the Civil Aeronautics Board under the provisions of the Civil Aeronautics Act of 1938. Under the terms of the Act, the possession of a certificate of public convenience and necessity is a prerequisite to operation as a common carrier for compensation or hire in commerce between the states or in overseas or foreign air transportation. The Civil Aeronautics Board is empowered to issue certificates if the service meets the criteria set forth in the Act.
It is important to notice that the Act gives the Board no authority over intrastate carriers and no authority over carriers other than common carriers. The Act also gives the Board the authority to classify carriers and to exempt such carriers as it selects from the economic regulations provided in Title 4 of the Act.3

A very large number of operators have been classified as irregular carriers. In the summer of 1947 letters of registration were required for irregular air carriers. Rate filing and statistical reporting were also required from such lines. The definition of an irregular air carrier was not entirely clear, but it was required that there be no implication of a uniform pattern or normal consistency of operation.4 The classification was evidently intended to include all interstate common carriers not included in the certificated group or the non-certificated cargo carrier group. The latter group is now apparently obsolete.5 Very little is known about the operation of the irregular carriers. Even with the recently certificated cargo lines, published data are sparse, and statistical reporting techniques have not matured.

Table I shows, for the years 1946 to 1948, inclusive, the ton-miles of freight produced by sixteen certificated carriers, contrasted with those produced by nine non-certificated lines. Certain of the latter have now been granted temporary certificates. The lines included in the former group are presumably the so-called “trunk” lines, or larger carriers. The figures for the sixteen certificated carriers probably represent at least 99 per cent of all freight handled by the twenty-seven such lines, while the figures for the non-certificated carriers will understate, perhaps to a substantial degree, especially in the earlier observations, the traffic of that group. It appears that, once alive to the possibilities of air freight, the certificated lines expanded their traffic rapidly, while the non-certificated carriers have probably done little more than hold their own.

### TABLE I

**Comparison of Freight Ton-Miles Produced by Certificated and Non-Certificated Carriers 1946-1948**

<table>
<thead>
<tr>
<th>Thousands of Ton-Miles</th>
<th>16 Certificated Carriers</th>
<th>9 Non-Certificated Carriers*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
<td>18,686</td>
<td>25,184</td>
</tr>
<tr>
<td>1947</td>
<td>38,871</td>
<td>47,409</td>
</tr>
<tr>
<td>1948</td>
<td>70,438</td>
<td>48,115</td>
</tr>
</tbody>
</table>

*Includes Air Cargo, California Eastern, Flamingo Line, Flying Tiger, Mutual, Riddle, Slick, U. S. Airlines, and Willis. Certain of these carriers have now been granted temporary certificates.


The non-certificated cargo carrier classification was also established in 1947 (12 Fed. Reg. 3079 (1947)). These were carriers who had been operating on May 5, 1947, and had applied for a certificate of public convenience and necessity. The category was continued in the 1949 republication of the Economic Regulations (14 Fed. Reg. 4351 (1949)) but most carriers so classified received temporary five-year freight-only certificates in August, 1949 (American Aviation, August 15, 1949, p. 20).
The economics of air cargo cannot easily be separated from the economics of air transport. The principal business of most air carriers is the carriage of passengers. Only a few carry freight alone. Some passenger lines will operate planes fitted for the carriage of property only, and in those aircraft the freight traffic may often exceed that in other classes of property, which are conventionally classified as mail and express. Passengers' baggage is included with passengers in air transport statistics.

Table II shows the proportion of revenues which the certificated domestic carriers received from each class of traffic during a typical recent month, contrasted with the revenues received in the first three postwar years. It will be noted that while property revenues are important, it is usually the mail traffic which accounts for the bulk of such revenue. Freight revenues are generally small, but their importance is growing.

For the certificated air transport industry as a whole, however, it can be seen that passenger revenues constitute 80 to 85 per cent of total revenues. From this fact it can be expected that the prime purpose for which aircraft will be operated will be for the transport of passengers and their baggage. Under the law the post office has the right to demand the operation of flights on such schedules as it may lay down, but apparently this right has been exercised but rarely.

The difficulty of extricating air cargo problems from other air transport springs from the fact that aircraft are operated primarily for passengers and secondarily for mail. But when the passengers and their baggage and the mail have been accommodated, there is often room for additional loads. This may be the situation for one or more of several reasons:

<table>
<thead>
<tr>
<th>Traffic Class</th>
<th>1946</th>
<th>1947</th>
<th>1948</th>
<th>1949</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers</td>
<td>84%</td>
<td>86%</td>
<td>84%</td>
<td>81%</td>
</tr>
<tr>
<td>Express</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Freight</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Excess baggage</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Non-scheduled transportation</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other non-mail revenue</td>
<td>11</td>
<td>7</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Mail</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td>253</td>
<td>342</td>
<td>387</td>
<td>42</td>
</tr>
</tbody>
</table>

*Detail will not necessarily add to totals because of rounding. †Less than 1/2 of 1%. ‡None reported.


(1) The physical shape of an aircraft will be roughly that of a horizontal cylinder, faired in at both ends. Within the cylinder there will, of course, be a flat floor under the passenger cabin and flight deck, perhaps a fourth or a third of the distance from bottom to top of the cylinder. This leaves a number of enclosed areas unsuitable for the carriage of passengers, especially under the cabin floor and fore and aft where the fuselage is faired down. These are the areas in which baggage, mail, and other property may be stowed.

(2) Like a ship, an aircraft has limitations both on the gross weight it can lift and on the cubic capacity within the fuselage. The picturesque phrase which purports to describe the shipowner's ideal, "full and down," applies with equal force to air carriers. The most efficient load, on a purely technical production basis, is one which both fills the plane's cubic capacity and utilizes its whole weight-lifting ability. The amount of baggage and mail offered may not fully take up the capacity of the cargo pits and the lift of the plane. Hence, an ability to carry other property may remain.

(3) It may be necessary for the carrier, under the terms of its certificate, and to obtain both good utilization and directional balance of its equipment, to operate trips which are not well patronized by passengers. On such flights one possibility is to offer special inducements to passengers utilizing such trips. The midweek family plan, whereby a fare-paying passenger may take his wife and/or children at one-half the regular rate on certain days of the week, is an example of thinking in this direction. Another possibility, not necessarily exclusive of the first, is to carry property in the place of passengers. Property may even be carried in the passenger cabin. Some lines have facilitated this practice by the installation of collapsible seats.

The experience of the armed services during World War II was probably instrumental in bringing about the very large development of air cargo transportation during the postwar period. The domestic certificated carriers flew under contract to the army and gained much experience thereby. Moreover, the armed services trained a great many men in aviation. These men were usually young and very often had had no previous civilian business experience before entering the armed forces. Upon discharge, their interest and experience were focused on aviation. At the same time, large quantities of aircraft and aircraft components were declared surplus and set up for sale at very low prices. Military type transport aircraft could be bought for five to ten thousand dollars. Conversion to civilian certificated status might bring the total cost of a transport aircraft to something like twenty-five thousand dollars. Many men had accumulated considerable overseas pay and flight pay; moreover, in the economic climate of 1945 and 1946 a great deal of venture capital was forthcoming from local business interests. Hence, these prices were within reach of a considerable number of veterans. For a complex of reasons, of which undue optimism was one, but probably the inflation and lack of business experi-
ence were more important, most of these operators found themselves in financial difficulties quite quickly. At least partly as the result of this, the rates for both air freight and air express fell rapidly during the three years between 1946 and 1949.

When the air freight service was first inaugurated in 1944, the transcontinental rate was about $67 per hundred pounds. By the summer of 1947, the rate had fallen to $25, at which level it stabilized, but reductions continued to be made in the form of special rates on specific commodities.\(^7\) By the summer of 1948, rates as low as $10.50 per hundred pounds were being quoted for the transcontinental movement of certain commodities, such as cosmetics and nursery stock in large quantities.\(^8\) The decline in air express rates has been much less drastic. In the same period, the transcontinental air express rate has declined from about eighty-four cents a pound for large shipments to about seventy-four cents per pound.

All-cargo type aircraft will be used only on a small minority of flights, but whether passenger or all-cargo aircraft are used, the principles under which air cargo transport will be supplied will be the same: that is, the production of air freight transport will be a joint product with the production of other forms of air transport.

Because air freight transportation is produced jointly with other forms of air transportation, it is impossible to say that many specific costs are attached to the production of air freight transportation. The cost incurred will be due to the production of the agglomeration of air transportation service. The sensible way to allocate costs to a particular product in a multiproduct industry will be to ask the question, "How much would be saved if the product were discontinued?" Those costs which could be saved if the product were discontinued are the only costs which can reasonably be allocated to the product. If this question is asked in succession for each of the products produced by a multiproduct firm, the sum of the costs yielded by the answers to these questions will by no means necessarily equal the total costs of the firm. The remaining costs will be the overhead or burden costs which will not be due to the production of any particular product. Such costs can be assigned to particular products only by arbitrary methods.

If this question is asked of the air freight service of the certificated carriers, it will probably be seen that very little would be saved if the certificated carriers were to discontinue the air freight service. There would be some expenditures, of course, which would be eliminated: the advertising of air freight, the publication of tariffs, and similar matters, but almost all flights would be operated in any event to carry passengers and mail. Hence, to the certificated carriers, the cost of the air freight service is likely to be quite low. To the cargo carriers the costs of the air freight service

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\(^8\) See, as examples, Slick Airways, Inc., Official Airfreight Commodity Tariff No. 5-B, 1st Revised page 4-D, May 2, 1949; and United Air Lines, Air Freight Memorandum Tariff for San Francisco, August 1, 1948.
service will be higher because they have no other traffic for which, if they did not render freight service, they would operate aircraft anyway.

II

There is another form of cost, however, which may be important to carriers of air freight. The cost will be measured by the loss of revenue, if any, on traffic diverted from the higher-priced air express service to the lower-priced air freight service. There is no way in which this can be measured. But as we have seen, the rates for air freight have been reduced much more drastically than the rates for air express. It must certainly be true that if there were no air freight service offered, some of the traffic now moving by air freight would nevertheless move by air express and pay substantially higher rates. There must have been some diversion from express, but clearly that has not been the main source of freight traffic. Table III contrasts the growth in air freight and air express since 1945, when separate reporting for the two classes of traffic was first introduced. It will be seen that while air freight traffic has grown many fold in both physical volume and revenue, air express traffic shrank some 20 to 25 per cent from its peak level. Table III also shows the revenues which have been received from express and from freight traffic. It will be seen that in recent periods air carriers have been deriving somewhat more revenue from freight than from express.

Very little is known about the price elasticity of demand for various types of transport. As already pointed out, the freight service is to a considerable degree a substitute for air express service, the main differentiation lying in terms of the size of the shipment which will be carried and, to a lesser extent, in the quality of the ground service provided. It must certainly be true that the inauguration of the freight service must have caused some traffic which would otherwise have moved by express to move by the lower-priced air freight service. Nevertheless, it seems quite probable that the total revenue derived by the air carriers from the carriage of property is larger with the two present classes of service than it would have been if the carriers had continued to offer express service only. In 1948, combined revenues

| FREIGHT AND EXPRESS TRAFFIC AND REVENUES OF CERTIFICATED DOMESTIC AIRLINES, 1946-1949 |
|---------------------------------------------|-------------|-------------|-------------|-------------|
| (1) Fiscal Years ended June 30               | (2)         | (3)         | (4) April 1949 at annual rate* |
| 1946 | 1947 | 1948 | 1949 |
| Express ton-miles (000's): ................ | 18,235 | 28,103 | 29,420 | 22,692 |
| Freight ton-miles (000's): ................ | 5,066 | 22,826 | 53,401 | 114,492 |
| Express Revenues ($000's): ................ | 7,656 | 11,084 | 9,819 | 7,728 |
| Freight Revenues ($000's): ................ | 1,659 | 6,189 | 11,057 | 21,588 |

*April, 1949, traffic and revenues multiplied by 12. No adjustment is made for seasonal variation, if any. Source: Columns (1), (2), and (3): ANNUAL REPORT OF THE CIVIL AERONAUTICS BOARD 50-52 (1948); Column (4): American Aviation: July 1, 1949, p. 48; July 15, 1949, p. 56, and August 1, 1949, p. 55.
TABLE IV
TRANSCONTINENTAL FREIGHT RATES BY THREE TRANSPORT TECHNOLOGIES,
JULY, 1949
Dollars per hundred pounds

<table>
<thead>
<tr>
<th></th>
<th>SAN FRANCISCO TO NEW YORK</th>
<th>Minimum Wt. required</th>
<th>Carload or planeload rate on class traffic</th>
<th>Carload or planeload rate on fresh vegetables</th>
<th>Minimum Wt. required for carload or planeload rate on fresh vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General 1st class traffic</td>
<td>Carload or planeload 1st class traffic</td>
<td>Minimum Wt. required for carload or planeload rate on class traffic</td>
<td>Carload or planeload rate on fresh vegetables</td>
<td>Minimum Wt. required for carload or planeload rate on fresh vegetables</td>
</tr>
<tr>
<td>Air Freight</td>
<td>$26.00</td>
<td>$18.20</td>
<td>16,000*</td>
<td>$10.50</td>
<td>10,000*</td>
</tr>
<tr>
<td>Rail Express</td>
<td>15.84</td>
<td>11.88</td>
<td>13,000*</td>
<td>5.28</td>
<td>13,000</td>
</tr>
<tr>
<td>Rail Freight</td>
<td>9.82</td>
<td>9.82*†</td>
<td>†</td>
<td>2.23</td>
<td>20,000</td>
</tr>
</tbody>
</table>

*Commodity rates will be provided for almost all rail carload traffic. No distinction between carload and less than carload rates provided on transcontinental class traffic. The distinction, if any, will be in the classification.

Source: Air rates from air carrier tariffs. Rail rates quoted by carrier traffic departments, July 29, 1949.

from freight and express were double those of 1945, although this phenomenon is undoubtedly partly due to a growth factor. The principal analytical reason for believing that combined freight and express revenues have increased is that air freight rates are now approaching the rates for the higher quality surface transport.

Table IV contrasts the rates by air freight, rail express, and rail freight which were effective during the summer of 1949. The table sets forth the general class rates which will apply on smaller shipments of one hundred pounds or more and also the general class rate applying on carload or planeload shipments (as the case may be) with the minimum weight required to obtain that rate. The table also sets forth the carload or planeload rate on fresh vegetables as an example of the commodity rates which carriers offer. It will be seen from Table IV that the margin by which air freight rates exceed surface transport rates is not extremely large and that this is especially true for general class traffic. However, the margin on commodity traffic is considerably greater. On the other hand, air freight rates are less than double railway express rates. On transcontinental shipments, air freight will ordinarily give second morning delivery while rail express is likely to take as long as until the fifth morning. Rail freight is likely to require nine or ten days for a transcontinental movement.

III

This leads us to the question of the nature of the demand for the air freight.

The quotation of transportation rates has become very complicated. The usual rate system contains a classification into which all commodities are fitted and then a set of class rates for all geographical movements. These rates are set up in a generally uniform and related system. Commodity rates, almost always lower than class rates, are then tailored to fit the movement of specific products between specific markets. Commodity rates are constructed on an ad hoc basis and do not constitute an integrated system. However, well over 80 per cent of the physical volume of rail traffic moves on such commodity rates. No precise statistics are available for either rail or air, but it is apparently true that commodity rates are moving a substantial portion of the air traffic.
service. In the simplest case where the air freight rate is no higher than the surface freight rate, shippers have nothing to lose by using the air service and they obtain speedier delivery. Moreover, for some commodities, air transport may involve simpler packaging than surface transport. Garments, for example, are hung on racks inside the aircraft while their surface movement requires folding and packing at the origin and unpacking and pressing at the destination. Garments have become a very large item of westbound traffic. But for most products, air transportation does not offer a simple substitute for surface transport at no extra transport cost. For most products air transport involves an increase in the transportation bill. The problem then becomes one of deciding which commodities are willing to pay a higher transport bill to obtain delivery at their destination in half or less of the time required by surface transportation. The value of a commodity is commonly thought of as an indicator of its ability to move by air, that is, the higher the value per pound at the destination the smaller proportion of that value will the transport charge probably be; hence, changes in the transport bill will produce only slight changes on the delivered cost of the product.\footnote{Cf. U. S. Department of Commerce, Office of International Trade, World Trade in Commodities, Part I, Air Cargo Potential Studies, published at intervals since July, 1944.} However, a little analysis will show that it is insufficient to use value alone as the test. There is no reason why the seller of a valuable commodity will pay a higher freight solely because it is a valuable commodity which is being shipped.

What is important in determining any transportation charge is the difference in the value of the commodity between origin and destination, and what is important in air transportation is the speed with which that difference will be eliminated. This will, of course, be the test in any high-speed, high-priced service. There would seem to be two main categories of traffic that pay a premium price for air transportation. One of these will be breakdown parts and emergency traffic, the other will consist of commodities which are in themselves perishable. The latter is fairly obvious. If lobsters are not delivered and eaten within a certain time after they are caught, they spoil and have no value whatever at any location. Cut flowers must also be delivered within a certain very limited time; otherwise they wilt and again have no value. Newspapers also, because of the perishability of news, fall into this category.

Air freight has brought about movements in perishable traffic which would not otherwise have occurred by any form of surface transport. Examples of such traffic will include orchids from Hawaii to the mainland and fresh figs from California to eastern markets. While our knowledge of air line traffic flows is quite limited, it seems probable that considerably less than half of the total air freight traffic is made up of perishable products. It was the assumption at the end of the war that perishable products would constitute the backbone of the traffic, but this assumption does not seem to have been borne out.

The nonperishable traffic offers much more challenging problems of analysis.
than does the perishable traffic. The larger item of traffic which we have denomi-
nated as nonperishable will even include some types of agricultural products ordi-
narily considered to be perishable. First-of-the-season movement of products like
strawberries and asparagus may very well be by air. Even though such shipments
are dispatched simultaneously by rail and by air, the air shipment will reach eastern
markets something like one week in advance of the rail shipment and during that
period will be able to command premium prices.

All kinds of surprising products may move by air on an emergency basis. If
a steamship is disabled in a foreign port because of firebox trouble, it may very well
be cheaper to fly a planeload of bricks half way around the world rather than pay
the wages and other overhead charges of the vessel for a month or more while those
bricks are taken out by sea. Automobile and aircraft manufacturers constitute an-
other important example of emergency users of air freight. These enterprises are
essentially engaged in assembling products from many sources. It is also their policy
to operate with very small inventories. Hence, an interruption in the source of supply
of any component is likely to result in a complete cessation of assembly operations.
When the component again becomes available, it is very common to fly it to the
plant at the outset until the supply lines of surface transport are again re-established.
In that way assembly can start again at the earliest possible date. These breakdown
and emergency shipments will obviously be of a sporadic and irregular nature; in
total, however, their movement will be substantial. They are responsible for a great
deal of the apparently odd and unusual types of air cargo traffic.

The air lines would thus appear to have three basic types of freight traffic:

1. The traffic for which they are, pricewise, a direct substitute for surface carriers.

2. Traffic which is so perishable that if it did not move by air it would not
   move at all.

3. The emergency traffic in which air service is used because it is faster than
   surface transport and results in net savings of some sort or other, either by
   commanding premium prices for early arrival or by avoiding continuing
   operating costs, possibly of a standby nature.

The demand for property transportation in general is probably inelastic, that is,
a price increase from the present level will not result in a proportionate decline in
traffic, and total revenue will be increased if the price is increased. To a considerable
extent this is due to the nature of government controls over transportation prices.
These controls make transportation prices more rigid over time than other prices.
Furthermore, for most types of transportation rate control, there is still a residue of
the old-fashioned anti-monopoly thinking which was current at the time that the
Interstate Commerce Act was first passed in 1887. Such thinking conceives of the
carriers as exploiting their customers and as earning excessive profits. It follows
that the function of regulation is to prevent both exploitation and excessive profits by
the carrier. The modern concept of the government agencies as claimant agencies
for the carriers is not very well integrated with this older notion. At any rate, it seems likely that the old notion has been and is sufficiently strong to hold rates down below the level which the carriers could charge if they were free to set their own prices without interference from either rate control or antitrust agencies. But while the market for property transport in general is probably inelastic, it does not follow from this that the market for air transportation is similarly inelastic. This is because within certain limits one transport technology can always be substituted for another.

The three types of demand for air transportation which we have distinguished can be portrayed in figure 1 as a, b, and c, respectively. Diagram a represents the generalization of the demand schedule for the transport of such products as already have a price comparable with surface carriers. Diagram a takes the form of the conventional oligopoly solution from economic theory. Thus, a further rate reduction on a commodity like clothing probably would merely represent a sacrifice in revenue on the part of the air carrier, since air carriage is already directly competitive with surface transport. An upward price adjustment, however, is also likely to result in a loss in revenue because the commodity might be diverted back to the surface line. Diagram b in figure 1 represents the demand schedule for perishables. Since these must move by air or not move at all, there is no problem of substitute technologies of transport. The demand schedule for perishables is hence a simpler function than the other demand schedules. The elasticity of the demand schedule for the transportation of perishables will require research in each individual transportation market. In many markets, however, the demand is likely to be inelastic. Diagram c represents a generalized demand schedule for other types of air cargo. While such types probably represent quantitatively the largest amount of air transport, the demand is also the most difficult to analyze. It is portrayed here with a kinked demand schedule. At high and low prices, the demand is inelastic, while in the center it is assumed there is an elastic range. This elastic segment of the demand schedule falls in the price range of the surface carriers. Demand is elastic in this range because small price reductions by air carriers may result in large diver-
sions of traffic from surface carriers. At prices above and below that level, however, demand is likely to be inelastic. At low prices it will be inelastic because most traffic will already have been diverted to air. At high prices its inelasticity is less certain; it is clear only that it will be less elastic than in the price range more closely competitive with surface carriers.

Because, as already pointed out, the additional costs to the certificated carriers for the carriage of air cargo will be quite low, it is extremely important that the air carriers properly appraise the demand for air freight transport in order that they may obtain the greatest possible earnings from that form of traffic. In fact, it is extremely important that the carriers make an appropriate estimation of the demand in each of the markets in which they sell their services. This is, of course, a very large order since the movement of passengers or of each commodity from each origin to every destination will constitute a separate market. Nevertheless, the additional cost involved in serving any one market under ceteris paribus assumptions of the other markets will be very low, so low that if the price is fixed with reference to the demand schedule alone and without reference to costs, the most profitable solution is likely to be quite closely approximated. These additional costs will be low for the reasons already explained: the jointness of production on most types of air transport service. Thus, a DC-3 providing local service from San Francisco to New York may make as many as seventeen intermediate stops. In the process of providing service from San Francisco to New York that same aircraft will also provide service from San Francisco to each of the seventeen intermediate stations and from each of those stations to the further stations on along the line. Such service will be provided not only for passengers and their baggage but also for mail, express, and all the various types of commodities which move by the air freight service. Hence, a price in each of those markets based upon a proper evaluation of the demand for transport in each market will cause the flight to produce the maximum possible total revenue. If it is given that the plane is going to fly this route and make these stops because, for example, it is going to handle the mail, then the additional cost involved in serving each of the other commercial markets will be slight. For passengers, those additional costs will consist of the costs of the ticketing and of providing the passenger with meals in transit and the like; and for property, the costs will involve the costs of billing and ground handling. If clerks and ground handlers are already required for handling the mail, then the costs may approach zero. At any rate, there is no presumption that the sum of all the additional costs involved in serving these other markets will equal the total cost of flying the aircraft.

Now the purpose of the airline, assuming of course that it is operated according to ordinary business principles, will be to maximize its profits. This is not, of course, quite the same thing as maximizing its gross revenue, since maximum profits are obtained by maximizing the difference between gross revenue and total cost, but if the preceding cost analysis is accepted, maximization of gross revenue comes close to maximization of profits.
While the joint production problems of the noncertificated cargo carriers are less obvious than for the certificated passenger carriers, they still exist. Thus, intermediate points are still served jointly with terminal points on through flights; and planes that fly west must fly east again. This joint supply of directional movement has contributed markedly to the downward pressure upon air freight rates. Freight carriers have been successful in filling their planes westbound with clothing, pharmaceuticals, and a great variety of other products. Eastbound traffic has been much more of a problem, although cut flowers have constituted an important item of traffic. Rather than fly planes east empty the carriers have felt constrained to offer very low eastbound rates, since, as already pointed out, if the plane is going to fly anyway the additional cost of flying it full of revenue traffic is so slight as to be negligible.

IV

As already indicated, air transportation is regulated under the terms of the Civil Aeronautics Act of 1938. As in any industry, difficulties both of a major and minor nature abound. The major difficulties of air transportation can, however, be traced directly to the statutory provisions of the Act. Like so many regulatory acts, the Civil Aeronautics Act seeks to accomplish more than one purpose; unfortunately, those purposes are not altogether mutually consistent. Thus, the Civil Aeronautics Act contains conflicting aims. The policy of Congress is set forth in Section 2 of the Act, although the six items there set forth are specifically stated as not being the only items to be considered by the Civil Aeronautics Board.

Section 2 (a) reads: “The encouragement and development of an air-transportation system properly adapted to the present and future needs of the foreign and domestic commerce of the United States, of the postal service, and of the national defense. . . .” Section 2 (e) provides for “the regulation of air commerce in such manner as to best promote its development and safety. . . .” Section 2 (f) provides for, “the encouragement and development of civil aeronautics.” Thus, the broad policy of Congress can reasonably be said to be the general encouragement of aviation in all its aspects. The more closely common carriage is approached, the greater the details of regulations specified in the Act. Thus, civil aeronautics is merely to be encouraged and developed, air commerce is to be developed and made safe by regulation, while three other parts of Section 2 of Title I and the whole of Title IV provide for the details of the regulations of carriers engaged in air transportation.

As just implied, Section 2 (b), (c), and (d), state the general nature of the regulation to be provided for air transportation. Most important for our purposes.

12 “Air transportation” is essentially defined as common carriage by air for such geographical operations as the Board controls, which essentially are all but intrastate. 52 Stat. 978, 979 (1938), 49 U. S. C. §401(10), (21) (1946).
13 “Air commerce” is essentially defined as for hire carriage by air. The geographical limits are broad enough to cover practically any operation. 52 Stat. 977, 978 (1938), 49 U. S. C. §401(3), (20) (1946).
14 “Aeronautics” is defined as the science and art of flight. 52 Stat. 977 (1938), 49 U. S. C. §401(1) (1946).
here and as an explanation of the present condition of the industry will be the policy declarations of the nature of competition to be provided in the industry. Section 2 (b) contains a reference to the fostering of sound economic conditions in the industry; (c) provides for the prevention of unfair or destructive competitive practices; while (d) calls for "competition to the extent necessary to assure the sound development of an air-transportation system properly adapted to the needs of the foreign and domestic commerce of the United States, of the Postal Service, and of the national defense."

The broad impression given by the statement of policy in the Act is that aeronautics of all sorts should be developed and encouraged but that competition, and particularly competition in air transportation, should be minimized. That impression is substantiated by the certificate requirements of Title IV. Thus far, the certificate has been the keystone of public regulation. Section 401 (a) makes the certificate of public convenience a prerequisite to operation as an air carrier in air transportation. Section 401 (d) (i) provides that the Board shall issue a certificate if it finds the applicant to be fit, willing, and able to provide the service and if "such transportation is required by the public convenience and necessity; otherwise such application shall be denied."

Again the presumption appears to be against the issuance of certificates and toward the minimization of competition in the industry.

In the literature of theoretical economics it is well developed that, with one exception, departures from perfect competition result in smaller output and higher prices than will be the case in a perfectly competitive market. That exception requires the existence of internal economies of scale. It is difficult to be sure whether or not there are economies of scale. For technical reasons this is a point which probably can never be established, although judgment may be applied to the evidence. In the absence of economies of scale, the regulatory restriction of entry provided by the sections of the Act would appear to result in minimizing the size of the air transport industry while the other provisions of the Act, especially Section 2 (a), would appear to indicate that it is the intention of Congress to maximize the size of the industry. An air transportation system adapted to the present and future needs of the foreign and domestic commerce of the United States, of the postal service, and of the national defense will almost certainly be larger than an air transportation system adapted only to the present needs of the commerce of the United States. In the political state of the world today, it is not surprising to find a great deal of our air policy justified on

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16 E.g., Joan Robinson, Economics of Imperfect Competition 154 (1946). Miss Robinson argues that economies of scale are a necessary but not sufficient condition, and that scarce factors for which the monopolist does not have to pay full rent (i.e., pays them less than they would earn in a competitive market) are also a requisite condition.
national defense grounds, especially when questions of subsidy and other government benefits to the air carriers arise.

The provisions of the law seem particularly inconsistent if the air carriers are looked upon as a sort of civilian reserve of the air force which may be diverted from domestic civilian commerce to support the operations of the armed services in time of war. In time of war, the domestic commercial requirements upon all forms of transportation will be much greater than in peace time; hence, a domestic transportation system properly adapted to the needs of the national defense must be large enough not only to handle wartime commercial business, but also to serve as a reserve to the armed forces. Hence it follows that for national defense purposes and to serve the future needs of the commerce of the United States, a continuously larger air transportation system must be maintained than will be supported by the present commercial market alone. The requirement of a certificate of public convenience and necessity does not, of course, make it completely impossible to maintain such an oversize air transportation system with a limited number of operators. Nevertheless, it seems likely that the elimination of the certificate as a prerequisite to operation would result in the operation of more air transportation service, at the same mail bill, than is the case with the existing certificate requirements.\textsuperscript{17}

Because the Civil Aeronautics Act of 1938 was borrowed, at least in part, from the regulatory acts for other technologies of transport, it follows that certain of the problems arising in the administration of the Civil Aeronautics Act are common to those others. For example, how may the public convenience and necessities be established? It is undefined in the Act. In ordinary business operations it is usually assumed that a business which is able to remain in existence, that is, avoid bankruptcy, must be providing a service or product which the public considers necessary and hence is willing to pay for. The monopoloid characteristics of the certificate coupled with the flexible mail pay provisions discussed below make this ordinary test not very well applicable to air transportation. And because air transport is a new technology there is not even a historical reference which administrators may utilize as a guide to indicate public requirements. Decisions as to whether a particular service is warranted or not must be made largely in a factual vacuum.

The certificate requirement has been rather liberally administered and has resulted in an oligopoloid situation in air transport. Between any pair of cities there are usually as many or more air carriers than there are rail carriers. Table V shows

\textsuperscript{17} Some demonstration of this point appears to exist in the Los Angeles-San Francisco market. The Los Angeles-San Francisco market is one of the few large intrastate transportation markets in the country. Several noncertificated carriers provide services in that market, in addition to the services provided by the certificated carriers. The noncertificated carriers offer fares approximately half those of the certificated carriers. Because the fares of the noncertificated carriers are not very much above rail coach fares, it is obvious that there is a good deal more air traffic than there was before the operation of these noncertificated carriers. Nevertheless, the certificated carriers do not appear to have reduced the number of flights which they have offered since the inauguration of service by the noncertificated operators. Hence, in one of the few large markets in which there is no restriction of entry, considerably more air transportation seems to be provided than would have been provided by the certificated carriers operating alone.
selected pairs of cities and contrasts the number of air carriers with the number of rail carriers, the test in each case being the existence of through aircraft or through rail cars. But while new routes have been extended fairly liberally, the Board has been somewhat reluctant to permit new management to enter the air transport industry. Most new routes have been granted to the grandfather carriers already operating as of the cut-off date in 1938. Only rather recently have new firms been allowed to enter the industry. These firms have been awarded temporary certificates to operate the so-called “feeder” services, or freight only services. The freight carriers were essentially certificated by the “grandfather” technique. Only lines engaged in certain operations prior to May 5, 1947, were allowed to apply for certificates.

These recent decisions have brought some new management into the industry, but that new management has had to operate under rather considerable handicaps, especially the limitations upon operation which restrict the room for management judgment in the type of service to be offered and the frequency of that service, but even more importantly by the temporary nature of the certificate. The Board has already refused to continue the certificate of one feeder carrier, awarding it sufficient retroactive mail pay to permit it to liquidate without loss to creditors or investors. The uncertainty of the duration of the certificate, however, makes it difficult for management to plan ahead and to raise new capital.

The qualitative requirements on management ability represent another problem. Taken together, sections 406(b) and 1002(e) conceive that total air carrier revenue, mail and commercial, shall suffice to permit the air carrier to maintain and

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**Table V**

**NUMBER OF AIR* AND RAIL CARRIERS SERVING† SELECTED TRANSPORTATION MARKETS, JULY, 1949**

<table>
<thead>
<tr>
<th>Market</th>
<th>Air Carriers</th>
<th>Rail Carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco-Los Angeles</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>San Francisco-Portland</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>San Francisco-Chicago</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Los Angeles-Chicago</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Seattle-Chicago</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Chicago-New York</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Chicago-New Orleans</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>New York-Boston</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>New York-Washington</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>New York-Miami</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*Certificated carriers only. †Defined as through plane or train service.

develop its air transportation service under honest, economical, and efficient management. No statutory test for management ability is provided. Under any circumstances it is extremely difficult to evaluate management, and the Civil Aeronautics Board does not appear to have undertaken to do so on any very detailed basis. Management authority, however, is substantially circumscribed by other provisions of the Act, and even apart from the mail pay provisions of the Act these other provisions might suffice to discourage management from very strong efforts at efficiency or economy. These other provisions of the Act include rate and route control. The Board has plenary rate control. Although rate suspension periods are limited to 180 days, this six months' time lag, the expenses of a hearing in Washington, and the possibility of denial, all serve to discourage management from rate and fare experimentation. Route control is, of course, provided by the certificate requirement, but it has often been the practice of the Civil Aeronautics Board, under the provisions of section 401(f), to establish various limitations upon such route certificates as are issued. Restrictions may include the prohibition of local flights along the most heavily traveled segments of the route, thus requiring the carriers to operate flights from more distant points with light loads; the requirement that all flights stop at every intermediate point, regardless of whether or not there is traffic to be embarked or disembarked at that point; the prohibition of nonstop flights over main segments of a route; and the prohibition on the carriage of passengers between adjacent local stations, hence reducing the load factor if seats are available between those stations. Such restrictions serve to prevent management from operating at its most economical and efficient level.

The mail pay provisions of the Act provide the Board with a set of problems somewhat different from those provided in typical public utility regulations. All certificated carriers except the freight-only group carry mail and receive mail pay. Although technically mail pay is not provided retroactively to make up deficits, if carriers can keep active applications for increased mail pay on file, deficits can be made up by such retroactive allowances. This possibility, of course, reduces management's incentive to conduct the most profitable possible commercial operations.

The statute provides a number of guides for the making of mail rates. Important among these is "the need of each such air carrier for compensation for the transportation of mail sufficient to insure the performance of such service, and, together with all other revenue of the air carrier, to enable such air carrier under honest,

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23 That mail pay cannot be made retroactive to time periods before the carrier filed for a rate increase was established in Transcontinental and Western Air v. Civil Aeronautics Board, 336 U. S. 601 (1949). Any of a very substantial number of proceedings could be cited as examples of the usual technique for fixing mail rates, which is to continue a temporary rate almost indefinitely, with occasional additional payments to make up such deficits as the carrier may have incurred. Several of these have been summarized by the chairman of the Board in recent congressional hearings. Hearings before the Senate Committee on Interstate and Foreign Commerce, Air-Line Industry Investigation, Pt. 1, 81st Cong., 1st Sess. 15-26 (1949).
economical, and efficient management, to maintain and continue the development of air transportation to the extent and of the character and quality required for the commerce of the United States, the Postal Service, and the national defense.” From this it follows that the earnings of the air carrier in the commercial market will affect the rate of mail pay. If carriers fail to exploit the commercial markets to the full, they are not subjected to the usual business penalties of reduced earnings and/or bankruptcy, but may merely obtain larger mail pay. Furthermore, it may very well be easier to cajole the Civil Aeronautics Board into granting the higher mail pay than to make the careful studies, market analyses, experimentation, and sales effort necessary in order to obtain maximum revenues from the commercial market.

The air carriers have made only limited efforts to establish rate structures that will maximize commercial revenues. The air lines have made considerably more progress in adjusting their rate schedules to the individual markets for freight traffic than they have in passenger traffic.

If one assumption is granted it can be easily demonstrated that it is socially more desirable for an air carrier to price individually in each market rather than to rely on a generalized, uniform, and formal price structure. It is clear, of course, that individual pricing will yield a larger total revenue. The necessary assumption for this argument is that if the carrier charged a uniform price, total revenue would be insufficient to cover total costs, and then either one of two things would occur:

(1) The carrier could not afford to provide the service at all; or,
(2) Substantial subsidies would be required to make up the deficit.

In the institutional situation of the air carriers, the latter is obviously the case. Granted the assumption that uniform pricing will not permit the carrier to survive on its commercial revenues alone, then the carrier must obtain its revenue either through:

(1) individual pricing in the commercial markets; or,
(2) increased mail payments.

Now it can be demonstrated that the former is the socially more desirable technique. If a separate price is charged in each market, according to what the traffic will bear, then those who use the service still have a choice as between using or not using the service; if they use the service they obviously feel that they are better off than if they had not used the service, since they are not compelled to use it. Clearly, nobody buys any goods or services unless he feels that by so buying he is better off than he would have been if he had not bought. On the other hand, a government subsidy, whether it be in the form of mail pay, a direct recognized subsidy, or the provision of airport and navigational facilities, falls upon persons who have no choice in the matter. Government funds can come from only two sources: taxes and deficit financing. If taxation is the technique, tax payers, of course, would have no choice but to pay the taxes required. If deficit financing is the technique adopted, it will probably, although not quite certainly, be reflected sooner or later in higher
prices generally, again a matter on which citizens have no choice. Proper pricing in the commercial markets, that is, pricing to maximize revenue, might not necessarily eliminate the need for subsidy, but it would certainly serve to minimize that need, and hence to leave more choice for the community.

The present formal rate structure, rather than a rate structure keyed to demand, has been encouraged by a sort of mystique of the Board, which leads the Board to the position that price should be related to cost, and apparently fully allocated average cost.\textsuperscript{25}

While it seems clear that congressional policy intends to maintain an air transport system larger than would be supported by the commercial market alone, the problem of how much larger has not yet been solved. Present policy, which is to pay the four largest carriers a rate for the carriage of mail much below that paid to the other carriers, leads to the concentration of excess capacity along certain routes. Thus we find between the main markets where traffic volume is always large, that even though a large number of flights are operated, those flights maintain relatively good load factors, while in the smaller markets the load factor is much poorer. Essentially it is on the north-south routes (except Eastern Air Lines) that the high mail pay and excess capacity is concentrated, while the transcontinental lines obtain better load factors. It would appear that airline capacity has not been produced on those routes which most need it.

### Table VI

<table>
<thead>
<tr>
<th>Carrier</th>
<th>(1) % of Total Rev.</th>
<th>(2) Cumulated % of Total Rev.</th>
<th>(3) % of Freight Rev.</th>
<th>(4) Cumulated % of Freight Rev.</th>
<th>(5) % of Pass. Rev.</th>
<th>(6) Cumulated % of Pass. Rev.</th>
<th>(7) % of Mail Rev.</th>
<th>(8) Cumulated % of Mail Rev.</th>
<th>(9) Freight Ton-miles % of Total</th>
<th>(10) Cumulated % of Freight Ton-miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 American</td>
<td>21</td>
<td>21</td>
<td>31</td>
<td>31</td>
<td>21</td>
<td>21</td>
<td>9</td>
<td>9</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>2 UAL</td>
<td>17</td>
<td>38</td>
<td>22</td>
<td>53</td>
<td>17</td>
<td>38</td>
<td>11</td>
<td>20</td>
<td>25</td>
<td>57</td>
</tr>
<tr>
<td>3 Eastern</td>
<td>16</td>
<td>54</td>
<td>10</td>
<td>63</td>
<td>13</td>
<td>56</td>
<td>6</td>
<td>26</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>4 TWA</td>
<td>13</td>
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<td>14</td>
<td>77</td>
<td>13</td>
<td>69</td>
<td>10</td>
<td>36</td>
<td>13</td>
<td>82</td>
</tr>
<tr>
<td>5 Capital</td>
<td>13</td>
<td>73</td>
<td>8</td>
<td>85</td>
<td>5</td>
<td>74</td>
<td>6</td>
<td>42</td>
<td>7</td>
<td>89</td>
</tr>
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<td>6 Northwest</td>
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<td>79</td>
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<td>10 C&amp;S</td>
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<td>91</td>
<td>3</td>
<td>67</td>
<td>1</td>
<td>99</td>
</tr>
</tbody>
</table>


Table VI reveals something of the nature of the concentration in the air transport industry. The ten largest certificated carriers are presented in rank order by total revenue for April, 1949. As of April, 1949, there were twenty-seven certificated domestic carriers in operation. The all-cargo carriers are not included in these figures, since \textsuperscript{25} Air Freight Rate Investigation, 9 C. A. B. 340, 344, 348 (1948).
they were not certificated until August, 1949. Three of the top four lines are transcontinental carriers. It will be seen that in terms of both freight revenue and volume, the ten largest carriers account for almost the whole of the industry total, while their passenger revenues exceed 90 per cent of the industry's. Even more apparent is the concentration in the six largest carriers, who handle more than 90 per cent of the freight business and almost 80 per cent of the passenger business. The six largest carriers obtain less than half the mail revenues, however, and the ten largest only two-thirds. The cargo carriers do not transport mail and hence receive no mail pay. From this it follows that most freight business is being conducted by lines which receive relatively little or no mail pay. The argument that freight transportation is subsidized by mail payments can thus be laid at rest, or at least restated in a modified form: freight transport is subsidized less than other classes of air traffic.

V

In air transport, as in any new industry, the evidence is not always sufficient to permit wise judgments of public policy. Certain conclusions do emerge, however:

1. Airline managements do not price their services in a businesslike manner. In part they are discouraged from so doing by the Civil Aeronautics Board, whose generosity with Post Office funds removes the ordinary penalty for unbusinesslike behavior: bankruptcy. The Board also often undertakes such detailed supervision of management as to discourage initiative.

2. Air freight has grown rapidly, stimulated in considerable part by the independent operators who entered the industry after the war under the exemptions established by the Board. Essentially they set the pace in exploiting an elastic demand, and the then certificated (passenger) lines followed. The carriers who transport nearly all the freight, however, receive either no mail pay or the lowest rate of mail pay; hence the freight traffic can be said to be less subsidized than other classes of air traffic.

3. For the passenger and mail lines, air freight is a by-product resulting from the physical nature of the aircraft and the nature of their operation. For any going air line, the sale of air freight service in any market can be treated as a by-product of its sales in other markets.

4. The important matter of the wisdom of the certificate requirement cannot be firmly evaluated at present. If there are no economies of scale, then the way to maximize the size of the air transport industry will be to abandon the certificate and open entry to the industry to all on equal terms. Evidence on the existence of economies of scale remains inconclusive.

5. The basic difficulties of the industry and its regulation spring from conflict in congressional policy: the concurrent expansion of the physical size of the industry and the restriction but not elimination of competition within the industry.