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IMPACT OF AIRLINE FARE REDUCTIONS OF 1978

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Summary of Session 114 at the 59th Annual Meeting of the Transportation Research Board
Summary Edited by Samuel R. L. Brown, Session Moderator

On January 23, 1980 David W. Bluestone, formerly of the Civil Aeronautics Board and now a consultant, presented a paper titled Lower Fares of 1978: Little Impact on Total Domestic Air Transport Revenues. There followed extensive discussion by panel members and from the floor. The following individuals constituted the panel:

David E. Raphael, SRI International

Gary Stern, Shilling and Company

Nawal K. Taneja, Massachusetts Institute of Technology

Alan K. Hogenauer, Trans World Airlines

Gene S. Mercer, Federal Aviation Administration

Dr. Bluestone, relying primarily on the high time-series correlation between total airline revenues and GNP, claimed that the higher revenues of 1978 could and should be attributed primarily to the surge of gross national product (GNP), and not to the low discount fares of that year. The response of travel demand to the fares was only about proportional -- or in other words, price-elasticity of demand is around unity.

The discussants and other participants did not, for the most part, strongly contest these conclusions. But they criticized the use of regression analysis of great aggregates, particularly in these times of high inflation and great structural changes in the economy, in the industry, and in the air travel market. They stressed the importance, in analyzing demand for air travel, of taking careful account of such changes. They instanced the rising importance of two-income families, of foreign air travelers, of the business-personal split of the market, of higher energy costs, of traffic diversion versus stimulation, of effects on costs and profits, of airline price discrimination, and of the changing business cycle.

TRANSPORTATION RESEARCH BOARD
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LOWER FARES OF 1978: LITTLE IMPACT ON TOTAL DOMESTIC AIR TRANSPORT REVENUES

David W. Bluestone, Consultant

This paper evaluates the impact of the lower fares of 1978 -- the first absolute decrease in current-dollar yield in a decade -- on the domestic air passenger travel market.

Regression models were tested primarily for 1969-1978, and 1978 deviations were evaluated. Relationships were calculated for the air travel market expressed in revenue passenger-miles (RPMs) and passenger revenues, in absolute and logarithmic form, against economic measures such as gross national product (GNP). The highest coefficient of determination (R^2) was between log revenues and log GNP, with an adjusted R^2 of .9959, an average annual deviation of ± 1.5 percent, and a 1978 deviation of +1.6 percent.

Conclusions:

* Demand for air travel is income elastic. The 1978/1977 increase in GNP accounted for 13.9 percent of the total 16.6 percent increase in passenger revenues.
* Price elasticity of demand for air travel is close to unity. However, the traveler's total outlay includes many more costs than air fare, which may mask the "pure" elasticity of demand for air travel alone.
* Fare levels influence the ratio of revenues to GNP over a long period, but not by year or short periods of years.
* Log RPMs vary with log constant yield and log constant GNP, with an adjusted R^2 of .9880. This high correlation is produced because changes in GNP directly caused changes in passenger revenues which translate through yield into RPMs.
* The above conclusions apply to the aggregate U.S., not individual markets.
* Unusual events will make it difficult or impossible to validate these findings using 1979 experienced data.

Introduction

The lower fares of 1978 -- the first absolute decrease in domestic average airline yield per revenue passenger-mile (RPM) in a decade -- did not appreciably increase airline dollar sales over what the national economy probably would have produced at the previous fare level.

There is a remarkably close correlation between the rate of increase in the passenger revenues of the domestic airlines (logarithm of revenues) in their scheduled services, and the rate of increase in the national economy as measured by the gross national product in current dollars (logarithm of GNP). The coefficient of determination (R^2), adjusted for the small number of observations, was .9959 for the years 1969-1978. The average yearly deviation of actual revenues from those calculated by the regression line was 1.5 percent, ranging between the extremes of -3.3 percent and +2.6 percent, and the year 1978 was underestimated by only 1.6 percent.

The lower fares of 1978 have been credited with increasing airline traffic considerably. However, they did not increase the total air travel market as measured in dollars. The surge in traffic came from the fact that the higher GNP produced more airline dollar revenues, and these dollar revenues produced slightly more RPMs through lower average yield. The increase in current-dollar GNP from 1977 to 1978 was 11.6 percent, which would have resulted in an increase of 13.9 percent in revenues based on the log revenue/log GNP regression equation. Current-dollar yield fell 1.4 percent, which would have increased this last calculated figure to 14.8 percent. Actual RPMs increased 16.6 percent.

Most attention in air transportation has been focused on the increase in traffic rather than in revenues. However, the logical economic relationship is between dollars of passenger expenditures on air travel, and dollars available in the national economy.

This relationship reflects the probable thought processes in the minds of potential air travelers. When considering the feasibility of a trip, a prospective passenger looks at the dollar price of the ticket -- for example, at a special low fare of $108 for a transcontinental trip in 1978. Probably not one person in a hundred knows, or cares, what the cost is per passenger-mile. Travelers for personal or pleasure reasons consider the dollar prices to various possible destinations -- as well as the other costs of staying there -- in deciding where, and whether, to take a trip. Similarly, business travel is measured in dollars to be spent; for example, companies which control travel may establish dollar limits and state "Your budget for travel is X dollars," and not "Your travel limitation is Y revenue passenger-miles."

The National Economy Models

Mathematical models were designed to test the effect on the aggregate travel market of lower fare levels in 1978. Basic air travel data is shown in Table 1 for the transport passenger revenues and RPMs of the domestic operations of route air carriers certificated by the Civil Aeronautics Board (CAB): trunk, local service, intra-Alaska, intra-Hawaii, and helicopters. It also shows three derived ratios: passenger revenues per $1,000 of GNP, and average yield in passenger revenues per RPM on both current-dollar and constant-dollar basis. Table 2 shows the most common indexes of the national economy in both current and constant dollars: gross national product (GNP), personal consumption expenditures (PCE), and disposable personal income (DPI), as well as the Consumer Price Index (CPI).

The basic data in the tables is shown from 1957. However, except for longer-term price changes discussed later, a shorter period was chosen for the basic regression analyses, since only the effect of the one year 1978 was to be evaluated. The beginning year for regression analysis was selected as 1969, when the CAB changed its definition of "domestic" from the continental 48 states to the 50 states including Hawaii and Alaska, which redefinition produced increases of 7.1 percent in RPMs and 5.0 percent in passenger revenues and a decrease of 1.9 percent in average yield. Excise taxes on airline tickets were not included, the level of which was reduced from 10 percent to 5 percent on November 16, 1962, and then increased to 8 percent on July 1, 1970. Neither were the revenues and traffic of commuter lines included, whose expanding operations for the 12 months ended June 30, 1978, included over two hundred companies accounting for one billion RPMs, or a little more than one-half of one percent of the domestic certified airline traffic.

The first comparison between models was to ascertain whether there was a higher degree of simple correlation between the national economy as measured by GNP on the one hand, and on the other

Table 1. Revenues and traffic in scheduled services total domestic certificated route air carriers.

Year	Passenger Revenues: Million Dollars	Passenger Revenues: per $1000 GNP	Revenue Passenger-Miles (Million)	Revenue per RPM (cents): Current	Revenue per RPM (cents): Constant*
48-state basis:					
1957	1,348	3.04	25,379	5.31	6.30
1958	1,432	3.19	25,375	5.64	6.51
1959	1,722	3.54	29,308	5.88	6.74
1960	1,860	3.68	30,557	6.09	6.87
1961	1,951	3.73	31,062	6.28	7.01
1962	2,167	3.84	33,623	6.45	7.12
1963	2,374	3.99	38,457	6.17	6.73
1964	2,701	4.25	44,141	6.12	6.59
1965	3,142	4.57	51,887	6.06	6.41
1966	3,534	4.69	60,591	5.83	6.00
1967	4,260	5.35	75,487	5.64	5.64
1968	4,913	5.66	87,508	5.61	5.38
1969	5,662	6.05	95,946	5.90	5.37
50-state basis:					
1969	5,943	6.35	102,717	5.79	5.27
1970	6,246	6.36	104,156	6.00	5.16
1971	6,736	6.33	106,438	6.33	5.22
1972	7,565	6.46	118,138	6.40	5.11
1973	8,379	6.41	126,317	6.63	4.98
1974	9,758	6.91	129,732	7.52	5.09
1975	10,124	6.62	131,728	7.69	4.77
1976	11,855	6.97	145,271	8.16	4.79
1977	13,489	7.15	156,609	8.61	4.74
1978	15,507	7.36	182,669	8.49	4.35

Source: U.S. Civil Aeronautics Board. Handbook of Airline Statistics, Air Carrier Financial Statistics, Air Carrier Traffic Statistics, and Table 2.

* Current divided by Consumer Price Index (1967 = 100).

Table 2. Indexes of the national economy (all dollar figures in billions).

Year	Gross National Product: Current Dollars	Gross National Product: 1972 Dollars	Personal Consumption Expenditures: Current Dollars	Personal Consumption Expenditures: 1972 Dollars	Disposable Personal Income: Current Dollars	Disposable Personal Income: 1972 Dollars	Consumer Price Index (1967=100)
1957	442.8	680.9	280.4	414.7	306.9	453.9	84.3
1958	448.9	679.5	289.5	419.0	317.1	459.0	86.6
1959	486.5	720.4	310.8	441.5	336.1	477.4	87.3
1960	506.0	736.8	324.9	453.0	349.4	487.3	88.7
1961	523.3	755.3	335.0	462.2	362.9	500.6	89.6
1962	563.8	799.1	355.2	482.9	383.9	521.6	90.6
1963	594.7	830.7	374.6	501.4	402.8	539.2	91.7
1964	635.7	874.4	400.4	528.7	437.0	577.3	92.9
1965	688.1	925.9	430.2	558.1	472.2	612.4	94.5
1966	753.0	981.0	464.8	586.1	510.4	643.6	97.2
1967	796.3	1007.7	490.4	603.2	544.5	669.8	100.0
1968	868.5	1051.8	535.9	633.4	588.1	695.2	104.2
1969	935.5	1078.8	579.7	655.4	630.4	712.3	109.8
1970	982.4	1075.3	618.8	668.9	685.9	741.6	116.3
1971	1063.4	1107.5	668.2	691.9	742.8	769.0	121.3
1972	1171.1	1171.1	733.0	733.0	801.3	801.3	125.3
1973	1306.6	1235.0	809.9	767.7	901.7	854.7	133.1
1974	1412.9	1217.8	889.6	760.7	984.6	842.0	147.7
1975	1528.8	1202.3	979.1	774.6	1086.7	859.7	161.2
1976	1700.1	1271.0	1090.2	819.4	1184.4	890.1	170.5
1977	1887.2	1332.7	1206.5	857.7	1303.0	926.3	181.5
1978p	2106.6	1385.1	1339.7	891.2	1451.2	965.5	195.3*

Source: Economic Report of the President transmitted to the Congress January 1979 together with the Annual Report of the Council of Economic Advisers. U.S. Government Printing Office, 1979.

p - preliminary.

* Source: U.S. Department of Commerce. Survey of Current Business, May 1979, p. S-8 (Index CPI-W).

hand the travel market stated in either physical terms of RPMs or in economic terms of dollars. For RPMs, the constant-dollar GNP was used. The regression analyses show clearly that revenues were more highly correlated with an adjusted R^2 of .9942 as compared to RPMs at .9439. Of course, as noted later, most RPM models include an airline yield (cents per RPM) term, and this will be discussed later.

Chart 1 shows why the R^2s differ, with both revenues and RPMs plotted against GNP on scales of approximately equal spans. In every year, RPMs continued to grow, but more irregularly than revenues. In addition, inflationary trends were marked during this period, and the economy increased each year in current-dollar GNP, but there were three years in which constant-dollar GNP decreased.

The next comparison among models was whether the correlation was higher for absolute values, or their yearly rates of change (logarithms). The results were slightly higher for the log revenues with an R^2 of .9959 compared to the log RPMs with an R^2 of .9606 (and to log RPMs, log GNP, and log constant yield of .9880).

The third choice was among the three standard indexes of the national economy correlated with passenger revenues:

	Absolute	Logarithms
Revenues vs. gross national product	.9942	.9959
Revenues vs. personal consumption expenditure	.9928	.9949
Revenues vs. disposable personal income	.9878	.9903

Although very slight differences with such a small number of observations should not be considered conclusive, GNP was slightly better than the other two. This is also logical, since the broad measure of GNP includes business and industrial activity as well as personal purchasing power, and business travel is about as important in the total air transport market as is personal travel.

The relationship finally selected for evaluating 1978 was the regression line:

log revenues (in million current dollars) = .2433 + 1.1856 log GNP (in billion current dollars)

The Durbin-Watson test showed that there was no autocorrelation. In addition, when a term was added for average real yield (airline passenger revenues per RPM), the resultant R^2 was practically unchanged at .9953. As discussed later, there were other variables operating during the nine-year period, but their total potential for increasing the R^2 was only .0041. It is rare that such a high R^2 as .9959 is ever attained in correlations between economic series.

An extremely important conclusion as to the price elasticity of demand for air travel is a consequence of this very close revenues/GNP relationship. Elasticity of demand is an economic term for the change in demand relative to a change in unit price. Unity elasticity exists when there is a change in traffic volume resulting from a change in unit price such that the total revenues generated by the new volume of traffic at the new price are equal to the total revenues generated by the old volume of traffic at the old price; elastic demand produces an increase in revenues; inelastic demand produces decreased revenues.

Based on the analyses in this and the next section it is concluded that aggregate passenger revenues are very close to unity price elasticity. (They are, however, income-elastic, that is, they vary more than proportionately with the GNP). In other words, for aggregate air traffic in the U.S., an average passenger yield decrease does not increase passenger dollars generated, at least for the year in which the price decrease occurs.

It should also be noted that this conclusion applies to aggregate domestic revenues. No inferences should be made for individual markets. In total, business and personal/pleasure travel are about equal, and it may be that less-than-unity price elasticity of business travel about balances more-than-unity price elasticity of personal/pleasure travel. Individual market elasticity is extremely difficult to measure on any comparative basis, even if all necessary data were available: restrictions on number of seats and conditions for purchase and use, ratio of business to personal/pleasure travel, changes in aircraft types, changes in schedule timing, changes in quality of service, actions of competitive carriers, amount and effectiveness of advertising, economic conditions local to the specific market affected, etc.

Another complicating factor in trying to measure even aggregate air travel price elasticity of demand is the influence of the traveler's total outlay. This is discussed in the next section.

Airline Fare Level Effects

Airline fare levels are probably the most important of the other factors accounting for the average 1.5 percent deviation annually from the log revenues/log GNP regression line. Over the longer term, airline fare levels are shown on Chart 2 for domestic yield in current dollars and in constant dollars (current dollars divided by the Consumer Price Index), as well as the ratio of domestic passenger revenues to current-dollar GNP. In order to include periods of both increases and decreases in constant as well as current yield, it was necessary that the period examined be longer than the nine years used for the previous regression analysis.

The major periods of similar trends are indicated on the chart and can be summarized as follows:

	Average Annual Compound-Interest Rates of Change			
	Revenues Per $1,000 GNP	Yield		CPI (1967 = 100)
Period		Current Dollars	Constant Dollars	
	%	%	%	%
1957-1962	4.8	4.0	2.5	1.5
1962-1968	6.7	- 2.3	- 4.6	2.4
1969-1977	1.5	5.1	- 1.3	6.5
1977-1978	2.9	- 1.4	- 8.2	7.6

From 1957 to 1962, airline fare levels increased in both current and constant dollars. From 1962 to 1968 they both decreased. From 1969 to 1977, they increased in current dollars but generally decreased in constant dollars. In 1978 they both decreased.

The long-term relative upward trend of generation of airline passenger revenues per dollar of GNP roughly coincided with the downward trend of airline yield for these major periods. The greatest increase in revenues/GNP was during 1962-1968 while yield declined in both current and constant dollars. However, second highest gains were in 1957-1962 even though yield increased in both current and constant terms. Only third highest was the last year, 1978, although constant-dollar yields decreased the most. The lowest increase was in 1969-1977 when current yield increased but constant yield decreased.

Very generally, then, it may be that over a longer period of time, lower yields help increase the relative growth of airline revenues compared to GNP. However, there is no direct correspondence between fare levels and revenues/GNP, either year-by-year or by spans of 5 to 8 years.

Most models for airline traffic deal with RPMs, and include at least yield along with some index of income or purchasing power, and many also include other factors. For the same nine-year period used in the previous section for RPMs and GNP, a constant-dollar yield factor was therefore added. The multiple regression equation for 1969-1978 was:

$$\log \text{revenue passenger-miles} = 1.4219 - 1.1295 \log \text{constant yield} + 1.4510 \log \text{constant GNP}$$

The coefficient of determination (R^2), adjusted for the same small number of observations and also for the additional coefficient in the equation, was .9880, less than the log revenues/log GNP adjusted R^2 of .9959. Of course, differences in the coefficients of determination of such small magnitude in statistical correlations with so few observations are not necessarily conclusive, but they are at least indicative.

The cause-and-effect chain of logic appears to be this: a change in the rate of growth of the national economy (log GNP) directly causes a more-than-proportional change in the rate of growth of air passenger payments (log revenues) through income elasticity. These payments, because of unity elasticity of demand, produce more passengers at lower average fare, or fewer passengers at higher average yield, without appreciable change in total revenues. Therefore, there is a high correlation of RPMs with both GNP and yield, since the GNP causes the revenues which translate through yield into RPMs.

It should also be noted that not all the price change in 1978 need necessarily be attributed solely to the recent trend toward deregulation. Average current-dollar yields as well as constant-dollar yields fell for a six-year period in the 1960s long before the rapid loosening of fare regulation in the last few years preceding the passage of the Airline Deregulation Act signed on October 24, 1978. As Chart 2 shows, in constant-dollar terms, average airline yield has decreased steadily ever since 1962 with only two or three years of slight increase. The proliferation of innovative services and discount fares has been going on for a long time, although not as widespread, as rapid, or as publicized as in the last few years.

Other factors

Factors other than GNP and yield have their effects on airline passenger revenues and traffic. One of the more important factors which complicates the measurement of air travel price elasticity of demand is the fact that the traveler's total outlay includes more than the air fare. This outlay, for both personal/pleasure and business expenses of travel, includes such costs as hotels, restaurants, rental cars, amusements, etc. Their amounts should be included in any measurement of elasticity of demand for all travel.

However, their relative costs may increase at rates quite different from that of air fares. If, for example, these other costs should rise while air fares decrease, their effect might completely nullify the fare effect, producing no change in air travel demand. Thus, the elasticity of demand for travel including all costs can mask the "pure" elasticity of demand for air travel alone if we could measure it separately and accurately.

The existence of this effect of traveler's total outlay may be indicated in the brief textual table previously presented for the four periods of revenues/GNP and yield trends. It will be noted from the last column that the average annual compound-interest rate of increase of the CPI changed markedly from the two earlier periods at 1.5 percent and 2.4 percent to the later periods of 6.5 percent and 7.6 percent. This effect may be one of the explanations why the 1957-1962 period showed a high rate of increase in revenue/GNP, even though real yields were increasing, compared to the 1977-1978 comparison when real yield dropped over 8 percent, and 1969-1977 with the slowest rate of increase of revenues/GNP even though real yield actually declined. While, as noted, statistical methods are probably not precise with such a small sample and so many variables, the correlation analysis between log revenues/GNP, log real yield, and log CPI, shows a part correlation coefficient between the first two of .9279 and between log revenues/GNP and log CPI of .8795.

Other factors have been left out of all the above correlation analyses. Some of these factors at work during the last two decades that may have had some effect in increasing air travel were greater frequency of service and therefore convenience, more aircraft capacity, automation of reservations and other services to decrease delays in passenger handling, etc. Some of these have been separately included in some models, but there is danger of circular reasoning for some -- for example, do more departures and greater capacity cause increases in traffic, or do airlines' forecasts of more traffic cause them to add capacity and schedules?

The relatively high percentage increase in revenues/GNP during 1957-1962 may also have been due in part to the fact that jet aircraft were being first introduced then, with concomitant increases in speed and comfort. The sudden jump in 1974, during one of the few years in this period when constant-dollar yields increased, may well have been due in part to the fuel crisis causing some private automobile travel to shift to air; the Arab embargo on oil shipments to the U.S., and mandatory fuel allocation beginning in October 1973, probably had an effect on 1974 air travel.

There are longer-term factors and trends that do not necessarily proceed smoothly year-by-year to increase air travel relative to the rest of the national economy. Life styles change, as do the frequencies of multiple vacations, three- and four-day weekends, early retirements, etc. Sudden increases in consumer credit and decreases in indidivuals' savings rates add to passenger purchasing power in some years. The U.S. GNP causes U.S. citizens to travel abroad as well as domestically;

Chart 1. Revenues and revenue passenger-miles versus gross national product.

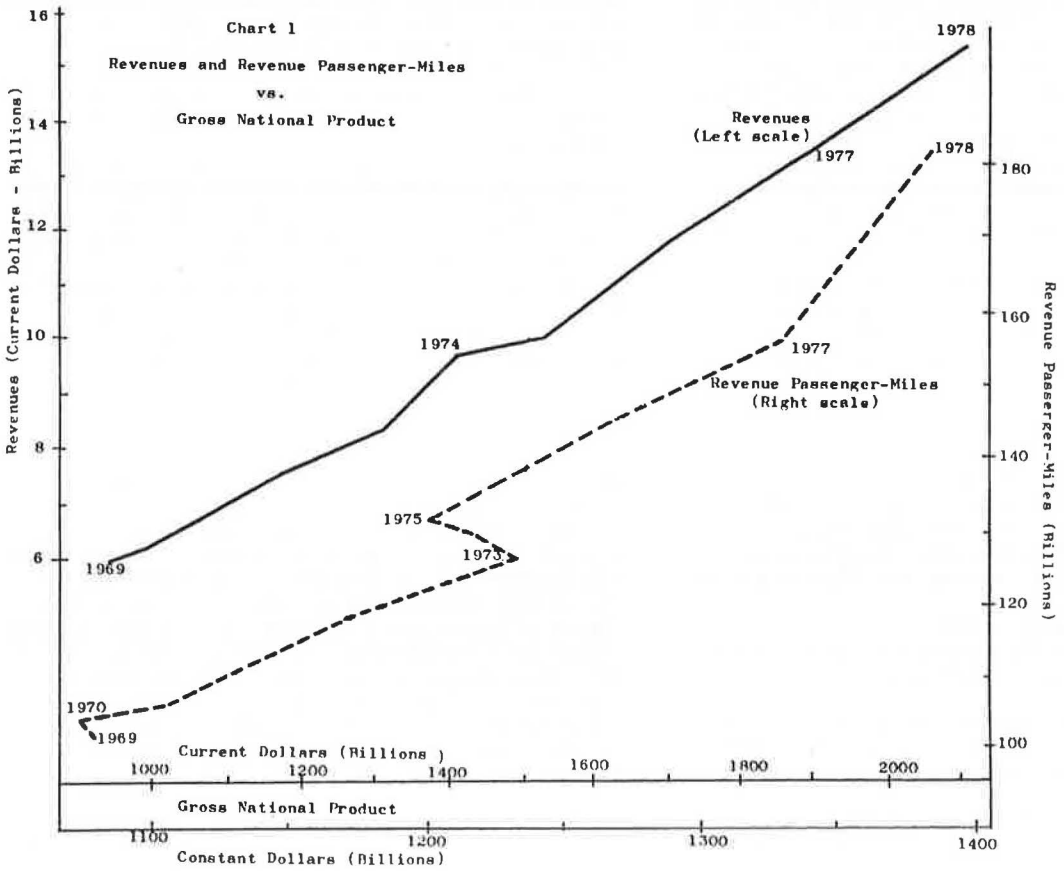
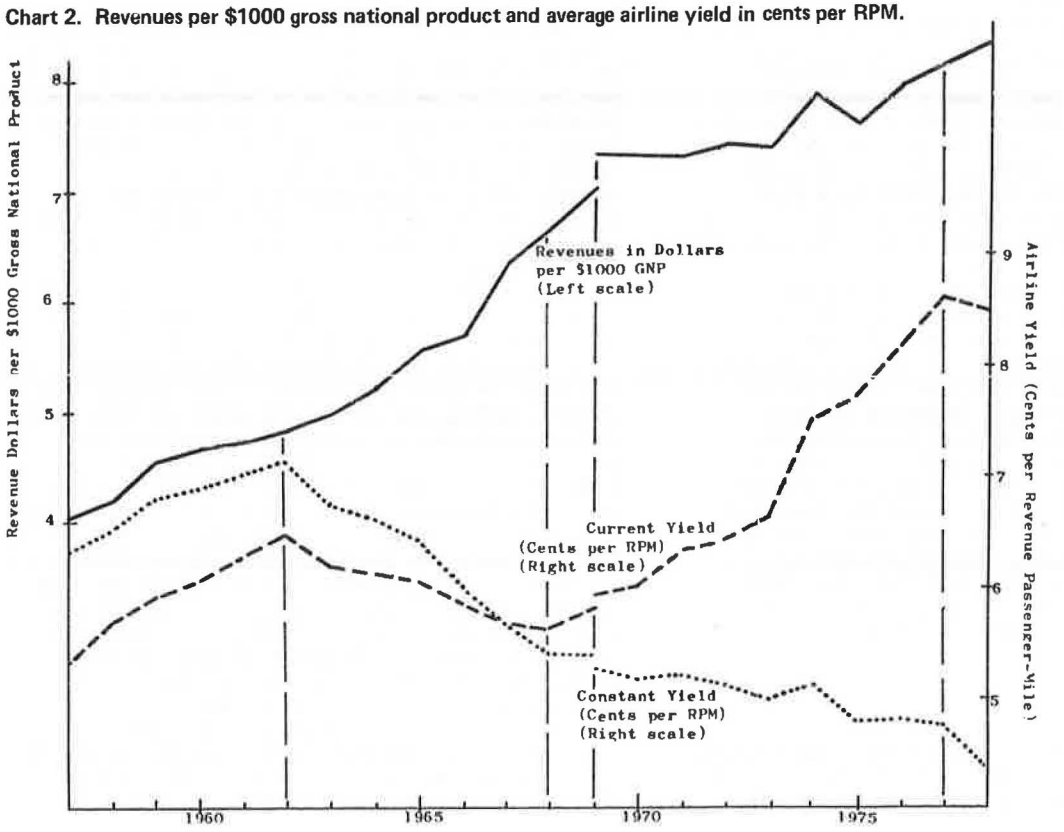


Chart 2. Revenues per $1000 gross national product and average airline yield in cents per RPM.



however, foreign travelers produce domestic travel with little relationship to the U.S. domestic economy. The air travel market is also affected by the "mix" of business and personal travel, the relative frequency of longer as compared to shorter journeys, the relative cost of automobile travel, etc. On a technical statistical basis, the period of years selected has an effect, changes in ticket taxes, changes in methods of reporting data, the advent of new carriers whose traffic and revenues are not immediately included in CAB data, strikes, aircraft groundings, etc.

A number of these factors are in the nature of sudden discontinuities without forecastable quantities for a mathematical model. The occurrence in 1979 of some of them will make it difficult if not impossible to update or validate the findings in this paper for 1979 experienced data. The gasoline shortage and "gas lines" for automobiles beginning in May 1979, following the loss of oil imports from Iran, combined with OPEC price and production actions, will have a marked and diverse effect on U.S. air travel -- increasing diversion from private cars to air transport because of gasoline shortages, but also limiting the fuel with which airlines can maintain and increase schedules. The strike of the largest U.S. airline for 58 days in April and May, 1979, and the issuance of almost 4 million half-fare coupons by it and another airline for use in the last half of the year, will have an impact. The grounding of 138 DC-10s for 38 days in June and July sharply affected many airlines' ability to handle more traffic. And air fare increases based on fuel price increases totaled over 25 percent for the year. All of these factors will be combined with a softening economy and the possible onset of a recession at the end of the year.

COMMENTS OF THE PANEL MEMBERS

Samuel R. L. Brown, Civil Aeronautics Board

I have no major disagreements with Dr. Bluestone on his conclusions, which are that the income elasticity is above unity and that the fare elasticity is around unity. I happen to think the fare-elasticity is more than unity. But my disagreements were not with that sort of conclusion, but with people who thought that it was around zero, so that if you raise fares 10 percent you get 10 percent more revenue, and if you reduce fares, you get no more traffic.

I have, however, three procedural questions to raise, before the others discuss the Bluestone paper. To do these things we need some sort of a mental picture, a model, so-called. Traditionally, this is an aggregate demand curve for air travel. Price is on the vertical axis and traffic on the horizontal axis. This demand curve moves to the right as income or GNP increases, and it doesn't move if they don't increase. Now, Bluestone assumes that the percentage slope of this curve, its elasticity, is equal to -1, because when he regresses against GNP alone, he gets a very high R^2 of .9959. The first question I raise is, would it not be better to estimate both price and income effects in the same model, so that we would study not only the movement to the right, but also the movement down or up the curve?

Secondly, would it not be better to do this by studying not the levels, but the changes that occur. In my experience, people's interest from year to year, and over the long term, is not so much what is the level of air travel. It is rather what is the percentage change going to be this year, and what is it going to be over the long term. If that is what we are interested in, we should study it directly, not using the levels of the variables. If you study the changes, regressing changes of traffic against changes of GNP and changes of fares in real terms, you will get correlations, but they won't be .9959 or anything like it. They will be about .67. And, the world being what it is, I think they are much better and more realistic estimates of how well we can do with this problem. That is my second general question. My third is: is the Bluestone approach, which concentrates on the relationship with GNP, useful for forecasting, and if so how should it be used for that?

David E. Raphael, SRI International

The Bluestone paper is an important one in that it brings out a key factor -- the price sensitivity of air travel.

Apparently, a large number of forecasters have been assuming that air travel is price-sensitive. A survey conducted in 1978 and presented at the 1979 Transportation Research Board Annual Meeting showed that of 124 analysts questioned, most assumed that air travel is price sensitive, with elasticity between 1.0 and 1.5. Some 16 percent assumed it is quite elastic, greater than 1.5. Less than 10 percent of them assumed that it was not price sensitive, that is elasticity less than 1.0. Personal travel was considered much more price sensitive than nonbusiness travel.

In another analysis, ICAO (International Civil Aviation Organization) did a recent comparison of 17 models of demand for air travel. Twelve of them used assumptions that traffic was price sensitive, with elasticities ranging from 1.05 to 2.3. The other 5 models assumed that it was not. Of the 9 models developed for the U.S. domestic market alone, 7 concluded that travel was price sensitive.

There are some problems with these kinds of comparisons. First, the estimates of price elasticity vary considerably, depending upon the regression method used, the choice of other variables, and the time interval. That was also true in the Bluestone paper, and also with the level of aggregation, as he pointed out. Most of the models do not separate travel by purpose of trip, length of trip, or characteristics of the traveller, such as income, life style, education and so forth. I liked the analogy that Bluestone used about the shoe costing more on the right foot than on the left foot. It appears to me that some of the travellers must have been getting on the aircraft with bare feet, because there did seem to be some price sensitivity to low fares in 1978. In this regard, looking at the characteristics of travellers, there have been a number of important changes taking place in both demographic behavior and spending patterns of potential travellers, that are not accounted for in any of the models. For example, two-income families are becoming an important, growing proportion of all U.S. households. Their propensity to travel frequently is far greater than that of other travellers. Some of this increased propensity is due simply to income effects, but there are other reasons as well.

A recent study at SRI forecasts the growth of two-income families. The data incorporated a survey of over 10,000 households in the

United States, the largest such survey ever undertaken of consumer spending behavior. We found that the number of two-income families, already enormous, will grow at a far faster rate than will all U.S. households during the next ten years. Both husband and wife are employed in 31 percent of the households today. By 1990 we estimate that four out of ten households will have two incomes. More importantly, by that time the total annual income, the combined income of dual earners, will be more than twice that of 1977, or about 1200 billion dollars in constant 1977 dollars. Two-income families will then account for more than half of all U.S. consumer income.

The two-income families, we found, have quite different perceptions about prices, credit, loans, the use of leisure time, and the need for convenience from most other families and individuals. These differences are not explained by their combined income. The income effect is important, but there are other things that are not explained by income or by GNP. Also, a surprising conclusion of our study was that most of the two-income families were not affluent, as that term has been normally used in earlier papers. Our definition of affluent was that the combined incomes of 1977 would have to be greater than $30,000. If less than $30,000 they would be non-affluent. This is contrary to most other research we have seen in this area.

There are other market distortions or changes not taken into account by the models of air travel demand. First, the persistent inflation rates of the 1970's are seriously distorting spending patterns and rates of saving. In 1978, the inflation rate was rising sharply through the entire year, reaching 8 percent, despite the fact that we had just experienced the worst recession in many years. What has happened is that the long term trend of inflation has been rising since about 1967, and for the first time since World War II this rising trend rate has not stopped. That is, the long term inflation rate kept rising both through the 1970 and the 1975 recessions, and we think it will continue to rise through the mid-1980's. This brings fundamental changes in both spending and savings patterns; for example in home buying, auto buying, and purchase of corporate securities, that are not accounted for by using the aggregate index of consumer prices or the GNP price deflator. In fact, the consumer price index probably overestimates the amount of inflation in the economy. The personal consumption expenditure deflator is more realistic, because it is changing with the basket of goods, while the consumer price index is tied to the 1972 basket.

As Bluestone pointed out, U.S. travel is a better bargain for foreign travelers than some other alternatives, such as travel to Europe and Japan, and total trip costs are very much more important. Foreign travelers are becoming a larger part of the total, although most models assume that their incomes, behavior, and spending performances are the same as those in the U.S. We are assuming a behavior which is homogeneous, when such is not the case. Also, higher energy costs are distorting traditional business buying and selling relationships. Thus, on the business side of flying, travel habits and patterns of business people are being changed. This may accelerate effects of the business cycle.

You may have noticed in one of the Bluestone charts that around 1968 there was a kind of fundamental shift in the U.S. economy. This goes on through the entire period of the 1970's and I think will continue through a large part of the 1980's. Accordingly, there are major structural changes going on that really cannot be explained by the traditional aggregate income effects that we have been using.

In sum, while this paper and other research on price elasticities are hopeful and important, I believe a more micro analysis of price sensitivity of air travel is needed before we can begin to understand the changing nature of air fares and their effects on travel. We need to rethink our previous assumptions about income and spending patterns in the light of new demographic and behavioral surveys. We need to incorporate more of the crucial structural changes our economy is undergoing, due to such factors as inflation, exchange rates, energy costs, and the business cycle itself, which is, I believe, quite different now than it has been in the last seven recessions. We need to incorporate these changes in our models and methods of assessing the future of air travel. We need to develop a formal, continuous, and systematic way of monitoring changes in consumer and business behavior in spending patterns that affect travel. I agree with William Nesbit and George Howard that we are getting into a period of great difficulty in assessing the meaning of in-flight surveys. I further agree that we need to look more at fundamental changes in consumer behavior and business travel behavior.

Gary Stern, Shilling and Company

I will make a few general remarks about the Bluestone paper, and then discuss an alternative approach to the issue of the price elasticity of demand for air travel, which I think we would probably all agree is critical.

To begin, I think that the conclusion in the title to Bluestone's paper is warranted, not only because of his results, but because of results that we turned up when we looked at 1978. It is very difficult to discern any significant impact on revenues as a result of the fare reductions. However, the fact that we are in general agreement does not imply that further examination is inappropriate. I think Brown's comment is well taken, namely, that if you really want to establish the elasticity of demand, it would be better to approach that problem directly, rather than rely on the remarkably good fit between current dollar GNP and current dollar revenue. In fact, I think it was really not all that remarkable. If you look at the graph, current dollar GNP and revenues have simply trended up together over most of the period, and that is largely the reflection of inflation. It reminds me of some of the old correlations that you can often turn up if you try. For example, there is a correlation between consumption of alcoholic beverages and teacher salaries that used to work out quite well. But I do not think we will want to draw the conclusion that there was a cause and effect relationship, or that the way to stimulate alcoholic consumption is to pay teachers better. So I think there is merit to some further examination. For example, if Bluestone's period of fit goes through 1978, it might be preferable to stop the regression in 1977, and then use the equation fitted through 1977 to see what would have happened in 1978, given the values of the input. Now as a practical matter with an R^2 as high as he has that may not make any great difference, but it would certainly be preferable not to use the 1978 information in fitting the equation, and then go back and find

out what we can learn about 1978 from this equation. I think it would be a stronger test to exclude 1978.

Having said that, let me sketch out an alternative approach that we have taken, and give you the results. Let me state the conclusions at the outset and then come back and try to fill them in a little bit in the time allotted to me. First of all, my work on the price elasticity of demand for air travel says it is less than one. The elasticity is not totally inelastic; it is not zero, but it appears to be less than one. This says of course that fare reductions should lead to such an increase of revenue passenger miles that airline revenues would be reduced. We feel that this was obscured in 1978 by basically positive economic conditions. I think that story is consistent with what has been said already.

For forecasting purposes, it is tempting to say, if the elasticity is less than one, then obviously, if you are cutting fares, you are heading for some kind of disaster sooner or later. The facts are, of course, that because of fuel costs or whatever, fare reductions seem largely to be over, and since midyear have been rising rather astonishingly. In the forecasting sense, the future implications of this are that fares are going up, and that is all to the benefit of the industry. I mention that because what really got us started on this project was what happened in the stockbrokerage business back in 1975.

To review a little of that history for you, in May 1975, negotiated commissions became the rule in the stockbrokerage business. Initially I think everybody said that is going to be a disaster. It will drive a lot of firms out of business. That will lead to consolidation, with Merrill Lynch and a few other firms like it, and that is all you are going to have. That prediction may well turn out to be correct. What happened, at first, when negotiated rates came in, the economy was coming out of the 1974-1975 recession. There was a bull market on the way. Stock market activity was good, and theunderlying effects of negotiated commissions were obscured for a good couple of years. Now if you look at what has been going on in the stockbrokerage business, you can see that there has been a lot of additional consolidation. A lot of firms have left the business. So our curiosity was stimulated by some of the obvious parallels with airlines, that we felt could exist. There are of course many differences, having to do with ease of entry and so forth. But some parallels could exist between increased competition in airlines on the one hand and increased competition in stockbrokerage on the other.

How do we get to our conclusions on fare-elasticity? In our work the key relationship turns out to be between growth and distribution of household income, and revenue passenger miles. In particular, we find that the percentage change in the number of households with real income in excess of $10,000 (on a 1972 base) correlates very well with the percentage change in revenue passenger miles. Everything is estimated in percentage changes, and the R^2 is about .9.

Now if you look at personal travel, I think that has some intuitive appeal. What does it mean? It says that travel increases with increases in the number of people who can afford it. However, it doesn't tell us very much about business travel and admittedly that is a weakness. Quite frankly, I have not yet heard any real explanation of business travel. Most explanations seem to fall back on personal pleasure travel, without much explanation of where business travel gets into the game. This leaves aside, of course, the obvious problem of perhaps radically different price elasticities between the two groups. I think that is unquestionably a weakness.

What you can say about the relationship we have and the business travel component are probably a couple of things. First, it may be that business travel is a lot less volatile, so most of the fluctuations that we pick up are in personal travel, and will be captured by real household income, the variable that we are using. It may also be that what determines the growth in the number of households with real incomes over $10,000 are the same kind of positive economic factors that stimulate business travel. If you want to use our relationships as a forecasting device of course you have to be able to forecast the key input, which is the increase or decrease in those households.

We find that we can do that with four macroeconomic variables. First, the unemployment rate: the higher the unemployment rate the lower the rate of growth of households with income over $10,000, which probably makes sense. Second, the rate of inflation, where again the relationship is inverse: the higher the rate of inflation, the slower the rate of growth in these households. Third, the aggregate growth in personal income, where the relationship is positive; the faster total income is going up, the faster the rate of growth of this group of households. Finally, we have a variable called net household formation, which again has a positive relationship; the more households being formed, the greater are those likely to have real incomes over $10,000. The reason is that household formation does not come out of the blue, but is something that can be postponed, delayed, or accelerated depending upon general economic conditions. Now, apply this relationship and these variables to 1978 and think about that for a moment. Almost everything going on in 1978, which was a reasonably strong year for the economy, was bound to stimulate air travel growth. Unemployment was falling, total real personal income grew rapidly, and household formation increased. The only negative factor was the rapid rate of inflation of 1978. So we would argue that most factors in 1978 were positive, and you could be very misguided if you looked at the 16.5 percent growth in revenue passenger miles and attribute a lot of that to the price decline. In fact, our model without using prices says that revenue passenger miles would have increased in 1978 by better than 11 percent. The actual increase was 16.4 percent, so there's a difference of a little over 5 percentage points.

The relative price decline in air travel as we make it, was a little over 8 percent. So if you look at a relative price decline of more than 8 percent, and if we are more than generous by attributing all the unexplained growth to prices, we get an elasticity that turns out to be about .6. Now we have tried several variations on that theme and we didn't get anything that was significantly greater than .6. So that at the moment is our best estimate of price elasticity. The implications that we do get further reductions in fares for the industry and for specific airlines, can be pretty directly implied. But now, of course, fares are going the other way, and perhaps the results over the next couple of years are going to be surprisingly good rather than surprisingly bad.

Nawal Taneja, Massachusetts Institute of Technology

I agree with the conclusions of Bluestone's paper, but I am not sure I am convinced by the methodology. I totally agree with his conclusions that GNP had a significant impact on traffic in 1978, and that yield did not have as much influence. That price elasticity turned out to be around one is also consistent with my own findings. The problem is that those conclusions are drawn from an aggregate model. In aggregate models you put in apples and oranges and bananas all together. Now that is not to say that those models are not good. But one has to be careful, and aware of the limitations of the model that one is using. What is the purpose of the analysis? If the purpose is to develop an accurate forecast, then an aggregate model is sufficient. R^2 is a reasonably good single parameter, from which one can conclude that the forecast is within x percent of what the results should be.

However, if the purpose is policy analysis for an airline wanting to know whether it should reduce fares or increase them, or reduce fares for a certain type of traveller, then I am afraid the aggregate models are going to give us some problems. For example, Bluestone pointed out that business travellers may have price elasticity much less than one, while pleasure is higher than one, and if you put them together they will come to around one. That may be true, but if you are running an airline, and would like to know what fares to charge, or what fare structures to create, that does not meet the issue. So for forecasting, knowing what the traffic might be in a given analysis or strategy planning, we may have some trouble.

When Bluestone introduced the yield variable and found that the R^2 had increased only slightly from the model without it, that would make me suspect immediately that there is a correlation between yield and GNP. That correlation may mean multicollinearity, in which case we are in trouble and must go back and analyze the results in more depth. If there is no multicollinearity, meaning no relationship between GNP and yield, then the results are reasonably good.

I suspect multicollinearity because of another result. When you put only GNP in an equation which on the left hand side has revenue passenger miles or revenue, it does not matter what coefficient you find in front of GNP. Then you try another equation in which you add another variable, say yield, and now you see a coefficient for yield which by itself is significant. Then we go back and look at what the coefficient is in front of GNP, and we find that is also significant and different from the one in our previous model where we had only GNP.

Now we have problems. Which is the right coefficient? All we know is that GNP is a significant explanatory variable of traffic, revenue, or whatever you want to call it, but we do not know what its contribution is. That depends on whether we use the first model or the second model. But we agree that R^2 is about the same in both cases. My only explanation is that there is multicollinearity, and a substantial correlation between GNP and yield; that is not to imply that it is cause and effect. It is probably just statistical.

This price elasticity number is a very difficult number to get hold of and the previous commentators have made the same point. It is also very easy to criticize the airlines, and say they do not know what they are talking about. But put yourself on the other side of the fence: say, I must do something to my fares. What should I do? I need some numbers. All we can do to get a price elasticity is to go to some type of disaggregate model, where we break out travel by business and pleasure. Try different variables, more related to one activity than to another. Bluestone mentioned a number of those. Try to include more than just the cost of the airplane ticket, also, for example, the cost of staying in hotels. I tried this myself for Europe and found that for transatlantic travel the best explanatory variable is to include the price of the ticket plus all costs -- hotel costs, restaurant costs, sightseeing costs and so forth. I can do a pretty good job of explaining transatlantic travel by country, but not overall. That is, I can explain why Germany is increasing and why Switzerland is going down. I forgot to mention the value of the dollar relative to the value of the local currency. That proved to be very important.

Why bother with all this analysis in order to disentangle the results of 1978? A number of airline people have said, and of course the CAB has said, that all that wonderful traffic growth was the result of price reductions. Profits, that $1.2 billion that the industry made, were due to price reductions, which in turn were due to deregulation. What, utter nonsense! First, the GNP and the economy had a lot to do with it. Second, some of this traffic was new, but much was just diversion filling up some of the empty seats. Since the marginal cost was very small, the additional revenue brought in by these deep discount fares of 50 percent or whatever, just literally translated to the bottom line. Well, what is wrong with that? Nothing, if all you want is planning for the short term in a one shot deal, a shot in the arm. That is wonderful. But, if you are going to buy some airplanes, new airplanes or old airplanes, and offer this 40 or 50 percent reduction, you are going to be in deep trouble. To increase load factors another 15 percent on top of the 15 percent that you have increased them already, will be very, very difficult.

So I want to leave with you the idea that we should not be looking at price elasticity at all. Maybe we should be looking at profit elasticity. What is the impact of a new fare level or fare structure on profit, and never mind whether it brings in more passengers. Bluestone would say, forget about passengers, what does it do to revenue? I am going to take it one step further, and say, never mind what it does to revenue, what does it do to the profit? Because if getting that extra traffic means that your costs are going completely out of sight, and you are going to buy new planes, more computer systems, hire more staff, and so forth, then maybe you do not want to carry that extra traffic. You can carry less traffic, make more money, and laugh all the way to the bank.

Alan Hogenauer, Trans World Airlines

Unfortunately, I found the paper -- both initially, and after many hours of re-reading -- to be an ultimately inconclusive and therefore somewhat disappointing mixture of the mathematical and conjectural, of the statistical and the subjective. This certainly is not a situation unique to this particular paper, but it is one which should occur with much less frequency.

I have written this, of course, prior to Bluestone's presentation, and before my colleagues have expressed their respective opinions, so perhaps some of these points will be moot by the time of their delivery.

By its title and expressed initial statement, the paper concludes that the lower fares of 1978 (which in terms of aggregate yield were down 1.4 percent from 1977 in current dollars) had little impact on total domestic airline revenues, or, that, in the aggregate, revenues would have been just as high (that is, up $2 billion from 1977 in current dollars) if the yield had been unchanged. These conclusions are reached by the process of correlating various air traffic and revenue measures with various overall economic indicators.

Unfortunately, the apparent power of the ultimately-selected correlation between log revenues and log GNP in current dollars and their regression equation is quickly negated by several aspects:

- Air travel is stated to be enhanced or constrained by a multitude of factors (lifestyles, real purchasing power, traffic mix), which in sum prevent any projectability of the basic findings.

- In spite of the high degree of correlation, the basic finding is also tempered by "limited observations" and applicability only to the aggregate market. Regrettably, no individual market light is cast.

- If no inferences can be applied to specific markets, this reinforces the futility of such sweeping generalizations. All of the characteristics varying among individual markets are at the same time relevant to the system as a whole.

Because of the aforementioned juxtaposition of the mathematical and the conjectural, the flow of the language in the final paper was difficult to follow. The methodological paragraphs never quite seemed to blend in with the more generic. And lengthy gaps - for example that between the presentation of the interesting grouping of years and their ultimate explanation - do not aid the reader's progress. Perhaps this is in part the result of the incorporation by the author of changes suggested in advance of today's meeting by several reviewers; a number of potentially appealing points (which I will note shortly) from an earlier draft did not survive to the final version.

It is not until we are more than half through the paper that we have a clearly stated summary of the author's logic flow: a change in the rate of growth of the national economy (log GNP) directly causes a more-than-proportional change in the rate of growth of payments (log revenues), which through unity elasticity produces more passengers at lower fares (or fewer at higher) without changing total revenues. Therefore, there is a high correlation of RPM's with both GNP and yield, "since the GNP causes the revenues which translate through yield into RPM's."

Here, I definitely disagree. It is not that changes in GNP, and the extent of discount fare availability, in combination create RPM's which at those yields produce total revenues? GNP causes the RPM's, which translate through yield into revenues. A traveller does not, of course, purchase RPM's directly, but he certainly does indirectly, by selecting his destination from his origin. Changes in GNP affect the consumer's ability to purchase these "indirect RPMS", and - as noted - the related costs of travel.

Towards the end of the paper "sudden discontinuities" in 1979 are blamed for preventing future application of a model based on limited historic observations. It would certainly seem as if these discontinuities are not limited to 1979; each and every year has had its share, yet they do not appear to have prevented computation of an historic statistical relationship.

The basic problem with the logic flow, I contend, is the omission of any reference to costs and profits. These are two of the victims of the review process I referred to earlier. While traffic rose, and in spite of the yield decrease, total revenues were up, total costs were also up - and have risen even more sharply since the 1977-78 interval on which we are concentrating. Chart 2 and Table 2 point up the real problem - the continued decline in constant yield. This decline was particularly exacerbated in 1978, when the largest relative change since 1957, based on the data shown, was recorded - and this was a negative 8.2 percent. Yield declined through much of 1979, although recent fare increases have begun a dramatic reversal of the unacceptable erosive posture.

Therefore, the "logical" economic relationship is not between dollars of air travel expenditure (revenues) and dollars available in the economy, but between dollars of expenditure (revenues) and the cost of the delivered product. The former may well determine the size of the potential total market, but the latter determines whether the product delivery was ultimately effective. While it is apparent that lower yields have increased the rate of revenue growth vis-a-vis GNP, what about costs?

The point is made that attention has been focused more on increases in traffic than in revenues. By whom? Certainly the airlines are painfully aware of the revenue increases which have been disproportionate to the increases in traffic and in costs.

The indices of consumer prices (up 232 percent) and disposable personal income (up 473 percent) in current dollars and 213 percent in constant 1972 dollars) have continued to rise throughout the period shown in the study. Revenues and RPM's have risen continuously, though at varying annual rates. It is noted that RPM's as estimated from the correlation would have been up 13.9 percent, whereas they were actually up 16.6 percent. Perhaps this is heavily dependent on the fact that the correlation, reflecting the historic relationship between GNP and RPM's, was radically affected by a program of fares directed at the pleasure traveller, and primarily on the long-haul, lower-yield segments. Thus RPM's would be up disproportionate to expected revenues derived from the historic proportions.

The most interesting part of this paper was the comparative analysis of the four groups of years, documenting a key finding: where the consumer price index was rising slowly (1957-1968), revenues per $1000 GNP were increasing more rapidly. Since 1969, the reverse has been true: prices have risen sharply but yield has declined steadily, and revenues have not risen proportionately.

The best summary of the situation is in the section "Other Factors"; although basically a recitation of likely influences rather than a specific quantification, it illustrates the complexity of the fare and revenue interrelationships. A few other observations:

- More departures and greater capacity per se did not cause increases in traffic. Intensified marketing and enhanced passenger appeal cause the ultimate increases.

- Foreign travel to the U.S. is related to the U.S. domestic economy. Relatively lower U.S. prices (as well as pent-up demand and basic appeal) do attract foreign travellers. Conversely, relatively higher European prices affect European travel by U.S. citizens. Both are clearly related to the U.S. economy.

- Air travel price elasticity is also compounded by "interference" from alternative uses for discretionary income, and other living costs as well, not just actual travel outlays.

- Somewhat on a "what if?" note, I wonder what the result of the correlation would be if 48-state data were continued from 1957 to 1978, rather than switching to 50-state data and limiting the observation base. The influences of both the low yield-characteristics of mainland-Hawaii and intra-island air travel, and the intra-Alaskan services seem to interfere with the more uniform air travel pattern within the continental 48.

- A brief observation on capacity, which is mentioned by the author only in passing. Capacity applies to the demand and the supply/cost sides of the equation. Relative to demand, capacity continues to be excessive and inefficient in the aggregate. Planning around a 55 - 60 percent acceptable load factor is no longer valid relative to sharply increased costs and lower average yields. Delivered capacity, in terms of offered available seat miles (ASM's), even where acceptably filled, is still but a fraction of the possible capacity of the current fleet, in terms of potential ASM's, even considering reasonable utilization, and is an unacceptable waste of increasingly valuable resources.

- And lastly, reference is briefly made to the commuter carriers, as being excluded from the traffic data base. While the one-half of one percent this represents did not have an historic impact, it will be wise in the future to reflect on the basic, and ultimately unchanged hierarchy of scheduled air transport:

Services	Yield	Was	Evolving
Local Feeder	Highest	Local Service	→ Commuters
Regional Feeder	Middle	Local Service, Regional Trunks	→ Commuters, Local Service
Long-Haul	Lower	Trunks → To merger, and the return to Feeder/ Trunk Networks	→ Local Service, Regional Trunks, Trunks

In summary, I would say, then, the lower fares of 1978 actually had a tremendous impact on domestic revenues, not because the fares themselves increased total revenues disproportionately, but because they were a part of the whole process of rapid change in which the industry continues to find itself. Perhaps the most important role the lower fares of 1978 will play will be as historic objects of nostalgic memory.

Gene S. Mercer, Federal Aviation Administration

We have a whole range of opinion on what the elasticity of demand is: from Brown at 1.5, to Stern at 0.6, and some agreement on unit elasticity. I see no necessity for me to continue some of the discussion that has gone on here, but I would like to comment on how we at the FAA could use a model such as this.

I agree basically with Bluestone that the fare reductions of 1978 probably had little impact on the total revenues of the air carrier industry. I also agree with his last statement, that the unusual events of 1979 make it impossible to use this model to evaluate what happened in 1979. But these are precisely the events that we have to incorporate into the FAA forecast. The FAA uses forecasts for policy analysis as well as for budget planning. The question that we would like to have answered is: with fuel and fares rising at rates nothing short of astounding, what is the air carrier situation going to look like in six or twelve months or in two years from today?

In the third quarter of calendar year 1979 we experienced year-to-year increases of 60 percent in fuel prices, and 9 percent in fares. In 1980, we may be looking at another rise in jet fuel prices of 60 percent. What is going to be the fare increase to compensate for this additional cost to the airlines? And we may even have a significant number of spot shortages in fuel availability. So, what are the limits of the relationships we have heard identified? These relationships have historically existed within some range of prices, and the demand elasticity for air carrier traffic may well have been close to unity. What about tomorrow when we have exceeded the range that we have found in the historical data base? Is there something else that we should be looking at which might help us to predict aviation activity for the coming few years?

I was interested in Raphael's comments about the structural changes going on in the industry and in society today, and the impact they will have on air transportation. These are the sort of things that we are going to have to evaluate to come up with reliable forecasts and to plan for future growth of the national airspace system.

There has been significant diversion of transportation from surface modes to air over past years. I wonder whether that diversion is going to be reversed, with the cost of air transportation rising so much. Bluestone mentioned that the high rate of growth of revenue per thousand dollars of GNP from 1962 to 1968 occurred just at the time when the new jet equipment was being introduced. We saw a lot of new traffic attracted to the more desirable form of air transportation at much lower rates. With the increasing cost of air transportation that we shall have over the next few years, I wonder what will happen to total travel demand, and to the way that consumers spend their disposable personal income. How much income is going to be available

for air travel? Will people revert to surface transportation from air transportation?

Many questions have been left unanswered by this particular paper. I think that a few years ago I would have been a prime proponent of forecasting revenues to get to an RPM figure. But now I am beginning to wonder.

David W. Bluestone, Consultant

I do not think I can reply in great detail. I agree with 90 percent of what I heard, particularly that a great deal more analysis, detail, and experience are necessary. In fact, one of the major objectives of the TRB Committee on Aviation Demand Forecasting is to encourage more research.

Many years ago I worked on elasticity in individual markets. I took 34 somewhat documented cases of fare reductions from data sent in by the carriers or submitted in formal Civil Aeronautics Board dockets, and I found a tremendous variety of results market-by-market. You usually lack all of this other information on schedule changes, and equipment changes, and advertising, and limitations or qualifications of the market. So this whole subject, not just elasticity, but marketing by individual airline and individual markets, needs a lot of work.

One of the best comments I heard was from an airline analyst who said it is not what fares you propose in an airline, but rather who proposes it. It has been a matter of personal judgment. There are so many of these factors that you pretty much go on judgment, guess, or a smattering of data, as one of our members said the other day. He said that data diddlers just adjust everything. To Mercer I would say, try this over the next several years as an aggregate, and then try to adjust if you can for some of these unusual things. CAB in the past has always tried to adjust for strikes and you can adjust for groundings. Some of these other factors, e.g., structural changes in society, are very difficult. Other adjustments could be made, but you will probably find as in most of our forecasting, that doing a great deal of detail work in statistical methodology is far less rewarding than working on some of the big underlying assumpations that you make about continuity in society, and life styles, and so on. Those are the unpredictable things.

I will recommend another one of my papers, which gets right into this. It was called "Hedging Against Errors in Forecasting." You are bound to be wrong. The real question is how much and when. In all the uncertainty, the certainty you have is that you are going to be wrong. How do you protect yourself or your client, as best you can, against these errors? The same thing goes for airlines. They try these experiments and they should watch them carefully. I once prepared, and the Board refused to send out, a form asking for information from the airlines before they try fare changes, together with their forecast of what would happen in the market. Of course nobody would put himself on the spot, any more than the Board would forecast what would be the outcome of some of its route cases. The results are sure to be different, and they would not put themselves on the record either. So basically I agree that a lot more work has to be done. This is necessarily a limited work.

Question and Answer Period

Q: George Sarames, Lockheed California Company

This is not so much a question as a comment. In analyzing aggregate statistics for the 1960's compared to the last few years, we observed that real GNP was up then more than GNP is up now. We also observed real yields. They went down in the 1960's, and they went down in the last couple of years. But the aggregate statistics are hiding many factors that have to be addressed.

For example, when GNP was going up in the 1960's, it was due to increases in productivity. Now GNP is still going up, but productivity has been going down the last couple of years. GNP was up recently because of many, many more hours of work, reflecting a tremendous increase in the role of women in the labor force. Also, recently, GNP was up one year and down another year. In the 1960's we had six or seven years in a row, when quarter after quarter showed an increase in real GNP over the previous quarter. So you can imagine that there was a great difference in consumer confidence and hence spending patterns. There was also a very low rate of inflation in the early part of the 1960's. I think it was about two percent and later about four percent. Now we have almost double digit inflation. So many factors are not considered when only aggregate GNP is analyzed.

Now look at the yields. Yields went down in the 1960's because of tremendous productivity improvements in jet aircraft, introduced in the late 1950's. These really took hold in the early 1960's. There was a four-fold increase in productivity. So yields went down but the service for the passenger was improved tremendously. For example, a much safer ride is being provided today than in the late 1950's. The fatality rate has gone down to virtually zero. And think of dependability, the quality of ride, the space, and the lounges. In recent times yields have gone down only because we were all being crowded together. Service is getting worse. These changes are important in trying to understand what will happen in the future. I think our aggregate models hide all these disaggregate factors that people have been talking about, and these are important.

Bluestone said that TRB is out to foster research. Let us foster the right kind of research. To me, trying to ascertain the national elasticity of demand for U.S. air travel is an exercise in futility. We are wasting man hours on it, when we should be studying the disaggregates. We act as if there really is a homogenous RPM, but in fact they are all different. The supply and demand characteristics of almost every major market are completely different. These are the things that we must understand, so let us not spend a lot of time on total aggregate. Then there will be a better understanding of the problem so the policy issues that Taneja brought up may be solved.

Eduardo Pina, Boeing Commercial Airplane Company

Q. Our company has been tracking airline profits and airline orders, and there is a .88 correlation. Any rational aircraft manufacturer wants to see the airlines make a lot of money and not see the cycles, because the down side hits the manufacturer pretty hard. This led to a discount fares research program at Boeing beginning about seven years ago with the major carriers. What concerns me is

that we see a lot of discussion, as Sarames pointed out, about the aggregate yield.

Discount fares are normally designed to address a segment of the market, and one has to study that segment and the response we get from that segment. Discount fares proposed in the last five years have been generally intended to drive load factors up through capacity management, and even off the peak demand periods. Diverting from a competitor, or if you are a scheduled airline from a charter carrier, is stimulation, as far as you are concerned. Diverting from yourself can be bad, but if the person you diverted is from a peak flight to an off peak flight, there is some compensation for you in the process. We have concentrated our research on estimating diversion and stimulation. Getting back to the set of fares that existed in 1978, our studies with the individual carriers, including Continental, Western, CP Air, Air Canada, United, Trans World, and American Airlines, showed that the stimulation rate of the fares in 1978 was about half the diversion rate.

For example, if you have a 40 percent discount, a 30 percent diversion, which was a typical number, would give you a 12 percent drop in revenue from diversion and a 4 percent increase in revenue from stimulation. So you will do a lot more work, carry more passengers, but you will make less money. If the average discount was around 30 percent you would see a 9 percent drop in revenue from diversion and a 10-1/2 percent gain in revenue from stimulation for a net 1.5 percent. Constraints that have been considered, including 30 plus days advance booking, have had a very nominal effect on stimulation, but a strong effect on diversion. Percent discount has a very nominal effect on diversion. If you are a business traveller and you can use a discount fare you do not care whether it is 25 percent or 50 percent. So diversion is almost independent of discount; it is controlled by fare conditions. So the general rule is that high discounts should have tough fare conditions. With low discounts you can have less strict fare conditions.

Again, in the 1978 situation, our analysis indicates that at the 16 percent growth, a little less than 8 percent was the net result of new traffic. Put that through the profit calculations and it contributed about two percent, which suggests that the fare conditions were not strict enough and the discounts were too large. We all know what happened in 1979.

I was disappointed to see a lot of discussion on regression analysis and its adequacy or inadequacy, and very little commentary on any studies of the fares that were introduced, and how much was stimulation and how much was diversion, and what was the net result. Has anyone done any such research that might get us closer to understanding the effects of the discounts in 1978?

A. David W. Bluestone, Consultant

Whenever an airline is attempting to enter a new market with fare reductions, or is cutting fares for some other reason, they just do not keep enough data on traffic before and traffic after. Once one of the airlines had a 7-30 discount where you got something like a 30 percent discount if you stayed more than seven days but less than 30. They did not get a very great traffic increase in that market. I asked how much of this traffic before was moving between seven days and 30 days. He said, "We don't have the data." Then how do you know what happened to that part of the market? How much was diverted? So I devised a form (which was never sent out by the CAB) to try to get at this kind of thing. How much did you spend on promotion and advertising? Who knew about these fare reductions? What, as our Canadian friends call them, are the fences around these fares to keep self-diversion out? They did not have the before and after experience documented. I would certainly like to encourage such research. Somebody has to do a lot of data collection and analysis and the competing carrier who does it will probably keep it very secret, so you will never hear about it anyway.

I would like to get back to some things Sarames said. One reason I did this overall probe was that I have been watching the emotional deregulation atmosphere increasing in recent years. One of their strong points is that deregulation leads to fare reductions which will lead to a big boom in traffic. I did this paper to see if that was true. I do not think it is true; I think it is an emotional appeal and they have never tried to test it. Emotions will probably change.

Sarames argues that you should not do aggregate forecasts. Yet a great number of forecasters, whether for airports or airlines, start with a national forecast. They even start with the national forecast of all types of traffic, surface and air. Then they calculate an increasing share of the total traffic for themselves. When I was working for the Air Transport Association as a consultant, I found that when you add up all the individual forecasts of airlines at an airport it was 140 to 150 percent of what each said the total was going to be. Each one was going to increase his share. So one of the reasons for an aggregate forecast is to keep the individual promoter, airline or airport, within balance.

For example, the Port Authority of New York and New Jersey has calculated the New York share of the total market. At least it gives you some sort of benchmark to start with, from which you go on your own and promote your own interest. On other things alluded to, I did not get into profits because my basic approach is that you get more traffic at roughly the same revenue. It will cost you more over a longer period of time to handle that traffic, and so your profits will go down. If you look back at the much maligned airlines with their past monopolistic holds on markets, you will find that they acted like monopolists, they tried to keep prices up. They were not allowed to, but they tried. That was to their own self interest because if you keep prices up, I think your profits are higher. If you lower your prices and get bigger volume, your expenses go up with that volume and your revenues do not.

Q: William Tucker, Air Transport Canada

I have a number of comments and a question. First is the question of whether regression shows cause and effect, and the common inference that it does. Obviously, regressions do not show cause and effect. We still hear the claim that GNP causes revenues, or causes revenue passenger miles. It does neither. Revenues are a part of GNP and both are caused by other factors. I am sure there is no disagreement from anyone on the panel, but I think we should be tidy with our language because laymen reading us will get caught up in that point.

With respect to elasticity, we are interested in the discussion about it, especially the range. One of the problems in this is the question of averaging. With busines and nonbusiness traffic

together the elasticity may be something like one. I have difficulty with the suggestion that elasticity is less than one for nonbusiness. In fact, I have difficulty with it being less than one in total. The airlines are rational organizations out for a profit, and would be increasing prices very rapidly if that were the case.

But on average elasticities, we must keep in mind that the average does not really exist in the real world. There is the analogy of what is the average human. A little spaceman came to earch, did a study, and reported back to his country that the average human has one breast and one testicle. That would do little to predict human behavior. So when we use average elasticity, as the TWA representative pointed out, that does very little to help him with marketing strategy.

On the other hand, averages in macro models serve a real purpose if your aim is for a different type of forecast. I think that is what Bluestone was getting at, to get an idea where the global market is going.

Now to my question. I would like confirmation that nobody on the panel appears to think that deregulation caused a net increase in traffic of significant amount. Is that so, and if it is, is there anyone in the audience who has that feeling? I would like to see if anyone has any evidence to show that. My own inclination is like the panel's: deregulation did not cause a significant increase in traffic, at least not to date.

Nawal Taneja, Massachusetts Institute of Technology

Q: Let me make a couple of points. First, I did a study in 1973 looking at all price elasticity studies that had been done to that time. There were 32 studies that I could find and the numbers ranged from +2 to -13.7. I have a graph in my office. Second, the issue of raising fares for business travel. I think you have to be careful there. If you were doing a study properly, and I am not saying you can because the data may not exist, ideally what you want to do is to estimate a price elasticity which is never constant, either over years or over market or over activity. I believe that price elasticity is a function of price itself. For a 10 percent reduction in fare, is it a 10 percent reduction from a $1,000 fare or is it from $50? Also, I think that it is important what direction you are moving. If you increase price by a certain percent, would the answer be the same as if you decrease it? Which direction are you going?

Price elasticity is a function of many things. The ideal situation will be very difficult to model because human behavior is very difficult to model. On the matter of business travel, if you are looking at prices 10, 15, or 20 percent higher, it does not matter. The businessman is still going to go. But if you are talking about a 900 percent increase, he is not going to go.

I also have an observation on Pina's comment. I did a survey, asking people last year if anybody had studied stimulation versus diversion and profitability and so forth. The answer was that only two organizations had done quantitative analysis. One was Douglas and one was Boeing. Their work is obviously confidential. But they both released it to me. All I can tell you is that they are conflicting.

William Tucker, Air Transport Canada

Q: May I just go back and ask whether anybody here does think that deregulation caused a significant increase in traffic in the last year?

David Bluestone, Consultant

A: I will address the fare reduction part of it. Some years ago I was working on a project on fares, and I made a list of the fare reductions the airlines had instituted over the previous 20, 25 years -- from the beginning of time. Using legal size paper, I could get it all single space onto one page.

They used to say that the optimist sets the price and everybody else has to meet it. Those carriers coming into new routes cut prices rapidly but not necessarily logically. When you try to get into a new market there are very few ways you can beat the established carriers except by big price reductions. Then the existing carrier has to meet it. So I was trying to measure the effect of the fares. I do see some effect of fares, short term. From the beginning of 1979 to the end of 1979 the average fare level went up 26 percent because of fuel increases. But adjusting for other things, I believe that with these tremendous price increases you will not get a proportionate decrease in airline revenue.

Samuel Brown, Civil Aeronautics Board

A: I will answer Mr. Tucker's question. Yes, I think that the fare reductions, which began with the freeing up of the charters in 1976 and 1977, did have a positive effect on carrier traffic and revenues. This is consistent with my opinions over many years.

David Raphael, SRI International

Q: I did a study of energy costs after the second round of fare increases. Right after the 1975-1976 period, the price elasticity was in a wide range for things like gasoline, home heating, and things like that. It was not until 1978 or so that we began to see a pattern that seems to be more realistic. In a paper I did about a month after the Airline Deregulation Act was signed in October 1978 I said it would probably take at least four years before we will really know whether the greatest effects of fare reductions have appeared, or whether there will really not be much effect at all, because the year-to-year elasticity, as we know, is generally much lower than the long-term elasticity. So it will take a while before we know.

Robert Campbell, Lockheed, Georgia

Q: We are interested mainly in cargo. Most of the comments seem to be about passenger operations. I wonder if anyone cares to say what he thinks of the value of deregulation for the cargo carriers.

Nawal Taneja, Massachusetts Institute of Technology

A: The industry, I believe, is divided on the issue of price elasticity for cargo. They are divided

about 50-50 on whether cargo is price elastic or inelastic. I am on the side that thinks that it is inelastic. You want to send this thing somewhere and it does not matter, within reason, what the cost is. So what is the difference whether you raise the rates a little or lower them? Some of the rates have to go up, and some of the rates will have to come down from the use of containers and so forth. The charges for insurance, incidental damage, and the rest have gone up 300 to 400 percent. What is 400 percent of 50 cents? You know it is not a big yield that you are talking about. What did deregulation do then? It allowed you to lower or increase fares and rates. Second, you can fly to cities that you could not fly to before. Are you really doing that? Flying Tiger is serving a lot more cities, but not with an airplane. They use trucks to bring it in and consolidate. Pan American is flying to a few more places and some of the other airlines have got a few more cities, but there is not that big a change in service. As far as the shipper is concerned, it is not that big a change. So it is very difficult to tell as of now what will happen. TWA dropped out of the freighter business, but they would have done that whether or not deregulation happened, because they were having a lot of problems with the 707s. They did not think it was the right type of airplane. I question that. Why can British Airways make money with it and TWA not make money with it?

James H. Gray, Virginia Department of Aviation

Q: I would like to ask whether deregulation has stimulated traffic. There is some evidence from discussions I have had with travel agents that indeed it has. There must have been many other countervailing forces, fuel price increases, and other fare increases. Travel agents are seeing, they tell me, a lot more customers who are new travellers. Of course, we always got some new travellers, but they are complaining that fares are very confused and that you will be turning some people away. It is taking them much longer to conduct the transaction. They are getting people who have never traveled before by air in increasing numbers this last year. I think it has stimulated a modest amount of additional traffic, but other influences are masking the overall total.

James Gorham, SRI International

A: I think that Taneja may be underestimating the effect of increase in cargo service. In particular markets there have been significant increases in service. One of the interesting things is that cargo is showing itself responsive to those services. United has cut back in service in some markets but has significantly increased it in others. The forwarders are moving into selected markets where they are finding lack of cargo capacity in prime time, with their own service and getting traffic. So, I think we have found not price elasticity but service elasticity in cargo right now.

William Nesbit, United Air Lines

Q: I would like to address a basic approach to measuring price elasticity which recognizes what the pricing strategy of the airlines has been. This relates to Tucker's question about fences and constraints. We know that during this period of time the base fares were going up while the new discounts were coming in. Now the real question on price elasticity is what is the slope of the demand curve? If the demand curve is absolutely vertical, elasticity would be zero. We generally accept that this is not the case - price changes do affect traffic. What the airlines have been trying to do in their pricing strategy is price discrimination by building fences to prevent diversion. This is another way of saying that airlines are trying to increase revenue by capturing more of the total area under the demand curve regardless of the slope of the curve.

Even if that demand curve is a relatively steep line, and price elasticity in the pure sense is -0.5 for example, if you can introduce a lower fare, and prevent diversion by means of restrictions on that fare, you can then increase total revenue. That is what the airlines have been trying to do and I would submit they have been doing it rather successfully in the last few years, particularly with capacity controls. If you take Bluestone's approach, and deal with aggregates, forgetting that there is successful price discrimination going on, you may well find that aggregate revenue went up when the average price went down and conclude that price elasticity here is greater than -1.0. But what really occurred was not that price elasticity is greater than -1.0 but that the airlines were successfully practicing price discrimination amongst their customers. To put it in economic terms, they were tapping the consumer surplus.

That is also what is going on with the first class fares. There are certain people in the market who are willing to pay more than the coach fare for some additional service, and so you have a premium fare which also is capturing more of that total area under the demand curve. I do not think very many people have approached it in that way. I think it is the reason that many studies have ignored this whole question of price discrimination. You have a schedule of prices, not a single price, and some people come to the conclusion that the demand curve is very shallow with high elasticities. I think that is a spurious conclusion. You must consider pricing strategy and price discrimination in your analysis.

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