The Changing Price Elasticity of Demand for Domestic Airline Travel

Consumers make economic decisions as to what they buy based largely on price. More specifically, the change in the amount of a good purchased is often highly dependent on its change in price. That measure of responsiveness is defined as the price elasticity of demand. Mathematically, it is often expressed as: E_d= - percent change in quantity demanded / percent change in price, or -(dQ/Q)/(dP/P). The minus sign is often omitted because price elasticity of demand is presumed to be negative. If $E_d = 0$, it is perfectly inelastic, a change in price does not affect the quantity demanded. If $0 > E_d > -1$, it is relatively inelastic, the quantity demanded does not increase at the same rate the price falls. If $E_d = -1$, there is unitary elasticity, both price and demand change equally. If $-1 > E_d$, it is elastic, demand increases more than the fall in price. It is presumed that the changes in price are small. If the price elasticity of demand is not greater (more negative) than -1, a drop in price can actually reduce overall revenue received by the seller.

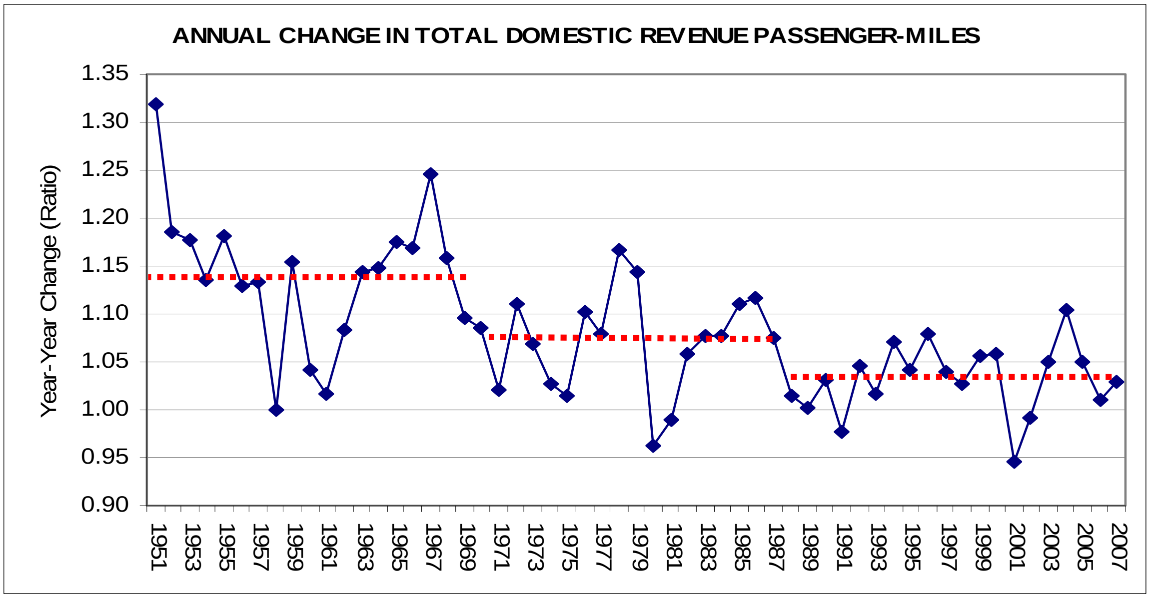
Airline industry observers have generally assumed that the demand for airline travel is price elastic. Indeed, one of the primary benefits expected with airline deregulation was a fall in the fare level and increased passenger traffic were regulatory price and service restrictions removed. Economists also generally view the effect of price changes in inflation-adjusted terms, e.g. "real" prices. This paper examines the effect of changes in price on the demand for U.S. domestic air travel, in both nominal and inflation-adjusted terms. The paper shows, contrary to general economic belief, that the overall price elasticity of demand for air travel has been inelastic (e.g. more positive than -1.0) since the early 1970's in both real and nominal terms.

Domestic industry price elasticity estimates are developed using multiple linear regression with demand measured in revenue passenger-miles as the dependent variable and several selected independent variables (price, the economy, consumer confidence, and several "dummy" variables). The paper is divided into four subsections: The Change in Air Travel Demand, The Regression Model Form, Model Variables, and Results and Conclusions.

Part A. The Change in Air Travel Demand

Graphed below is the year-to-year change in total domestic revenue passenger-miles (RPM's) from 1951 to 2007 (An RPM is one passenger travelling one mile). As shown, the domestic industry RPM's from year-to-year have shown a general decline in growth rate from 1951-1991, with relative stability since then. For purposes of analysis, this paper divides the general decline in growth of RPM's into three "steps": 1951-1968, 1969-1987, and 1988-2007. Two separate groupings of 1951-1991 and 1992-2007 are also provided, but use only one equation in real monetary terms and one equation in nominal terms for each period.

Figure 1. Annual Change in Total Domestic Revenue Passenger-Miles



Source: Ratio of actual data from U.S. Department of Transportation, Bureau of Transportation Statistics, and U.S. Civil Aeronautics Board, *Handbook of Airline Statistics*, 1972.

Part B. The Regression Model Form

In general, industry price elasticity estimates are derived from economic models using data series, as opposed to point or arc elasticities using far fewer data points. Selection of the type of model form used in part depends on the structure of the data and the statistical results of initial model tests. Econometric models are generally one of two forms, additive or multiplicative. The difference between the two forms is as follows:

Additive: Y =a(X) + b(X1) + c(X2), in which each individual independent variable has an independent, additive effect.

Multiplicative: $Y= (X)^a(X1)^b(X2)^c$, in which each independent variable interacts with other independent variables.

The bulk of aviation demand models have been of the multiplicative form to utilize that interaction. Fortunately, the multiplicative form can be readily converted to a linear form by simply taking the logarithms of all variables. One difficulty with both model types if using actual data is the effect of the numerical value (size) of the variables themselves. Different scalar size in the variables tends to mask the effect of which independent variable has a greater effect on the dependent variable. While one correction to scalar effects may be to use what is known as standardized or beta coefficients,[1] the models developed below will be based on the *percentage change* in the variables from one year to the next, rather than the *level* of the variable. In this manner the scalar differences are also eliminated. In Part D, Results and Conclusions, the development of the model form is shown in steps, using actual data.

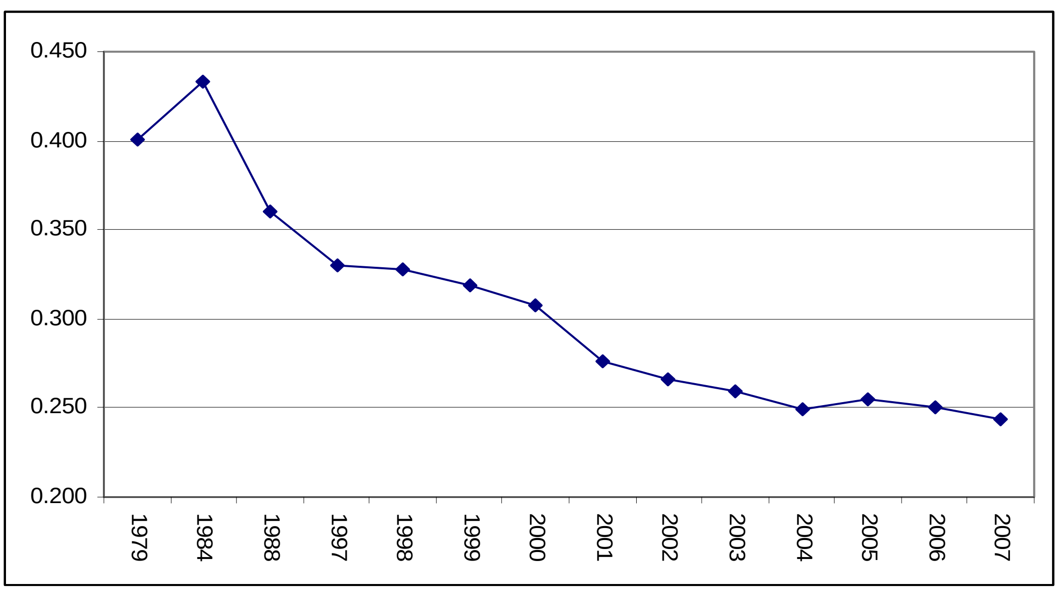
Models may also be developed with or without a constant (trend) factor. In a model without a developed constant, the trend is subsumed in the coefficients of the remaining independent variables, and may bias those coefficients. All equations in this paper use a constant term.

Part C. The Model Variables

The Dependent Variable: As indicated, this paper is attempting to determine the change in price elasticity of demand for the domestic airline industry over time. Here, the demand for air travel will be expressed as the yearly change in domestic industry RPM's. It could also be expressed in the change in passenger trips or enplaned passengers, but both of these metrics do not directly control for an increasing passenger trip distance or increases in enplanements due to the increased development of the airline hub-spoke system after airline deregulation. As shown in Figure 1, the general trend in the growth rate of domestic RPM's has been downward or flat.

As indicated above, there is a potential bias in using RPM's as the dependent variable. As shown in Figure 2, below, the percentage of origin-destination passengers traveling in markets below 500 miles has fallen considerably since 1979. At the same time, more longer-haul passengers are taking circuitous routings because of the pricing and service effects of the hub-spoke patterns of the deregulated airline industry. This tends to increase overall RPM's. These two effects may offset one another to some degree, but obviously affect both affect the composition of RPM's and yield (below) in different directions. A further study to examine industry price elasticity by mileage interval over time may indicate there are significant differences between changes in overall demand elasticity and elasticity estimates for selected mileage intervals.

Figure 2. Ratio of 0-500 Mile Passenger Trips to Total Passenger Trips

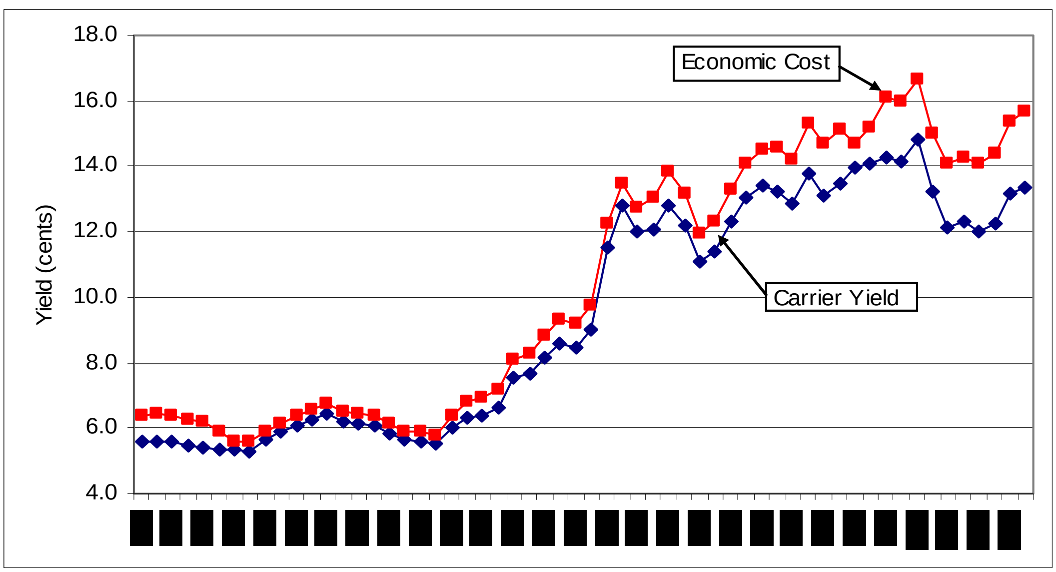


Source: U.S. Department of Transportation, *Secretary's Task Force on Competition in the U.S. Domestic Airline Industry*, Table I-5 for 1979, 1984, and 1988. 1997-2007 an annual compilation of quarterly data from *the Origin-Destination Survey of Airline Passenger Traffic*, U.S. Department of Transportation.

Independent Variables: A number of independent variables are shown and discussed below. Some additional surrogate variables were tested based on past experience but not included to conserve space. Some were deliberately included to show that the standard economic construct of using inflation-adjusted terms may produce no better results then using nominal data, if the nominal-value variables are selected with care. As in any model of consumer demand, price, a measure of the status of the economy, a "consumer confidence" variable, and several dummy variables were tested. These variables will be discussed in turn below.

Price: As with the dependent variable, price can be expressed in more than one form. It could be the total trip price, or as a rate-per-mile. As the dependent variable is RPM's, the rate-per-mile for the price of the ticket, or yield, has been chosen. Most models of aviation demand use yield, or carrier revenue divided by RPM's. However, as previously used by the now-defunct Civil Aeronautics Board, yield is here defined as the total economic cost to the passenger on a per-mile basis, not simply the average passenger airline cost per mile. Economic yield thus includes the revenue received by the air carrier, excise taxes, security charges, FAA infra-structure charges, airport construction charges (PFC's), and passenger excess baggage charges. (Excess baggage charges have significantly increased in 2008 with carrier attempts to increase revenue and reduce cost.) The historical difference between carrier yield and economic yield is shown below. Note that economic yield is over two cents per passenger-mile higher than carrier yield (about 17% higher in 2007), and up significantly from even the late 1980's.

Figure 3. The Difference Between Carrier Passenger Revenue per Mile and Passenger Economic Cost per Passenger-Mile

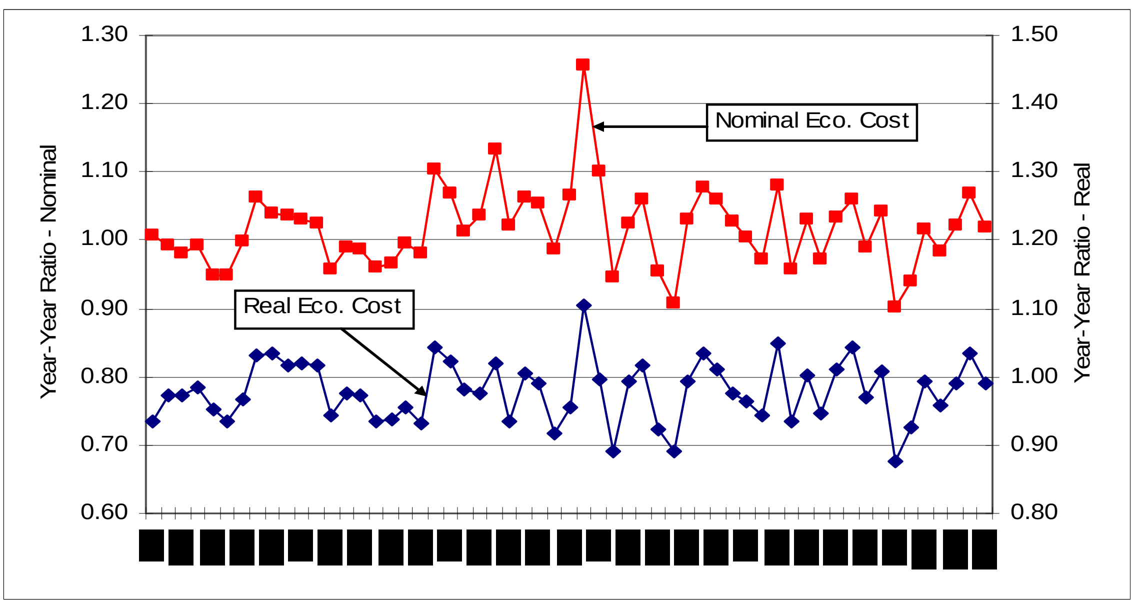


Source: U.S. Civil Aeronautics Board, *Handbook of Airline Statistics*; and CAB and U.S. DOT *Air Carrier Financial Statistic*, selected years; security fees from Transportation Security Administration, www.tsa.gov/research/fees/index.shtm; ticket tax rate from Air Transport Association, www.airlines.org/economics/taxes/DomTicketTax.htm; PFC tax from ATA, www.airlines.org/economics/taxes/PFCs.htm; and segment tax constructed from the rate (ATA) and enplaned passengers (DOT).

Price can also be expressed in real or nominal terms. Economists invariably use real terms, under the presumption that the increases in the general price level are recognized and discounted as simple price inflation by the general populace. This is unfortunately not the case, but will not be further discussed here. Below is the graph of nominal and real economic cost per passenger mile. Both will be used in the analysis of price elasticity below. Note that the change in real economic yield is simply a depressed version of the change in economic yield, since you are dividing by an inflation index that increases at a fairly stable rate per year. As discussed below, it is this depressed effect of real yield that likely causes the coefficient of the price elasticity of demand to appear more elastic in models employing "real" variables.

As with RPM's, there is a potential bias in using either economic yield or actual yield as an independent variable. Short-haul trips invariably are higher in cost per mile, since aircraft operating costs are highly affected by take-off costs. The longer the flight, the less the flight cost per mile. This is reflected in carrier pricing. Accordingly, a reduction in short-haul, higher-yield passengers will reduce average yield. On the other hand, most short-haul markets tend to be highly concentrated, and since fares are no longer regulated, carriers tend to extract a market premium in those markets. No adjustment was made for these passenger mix changes.

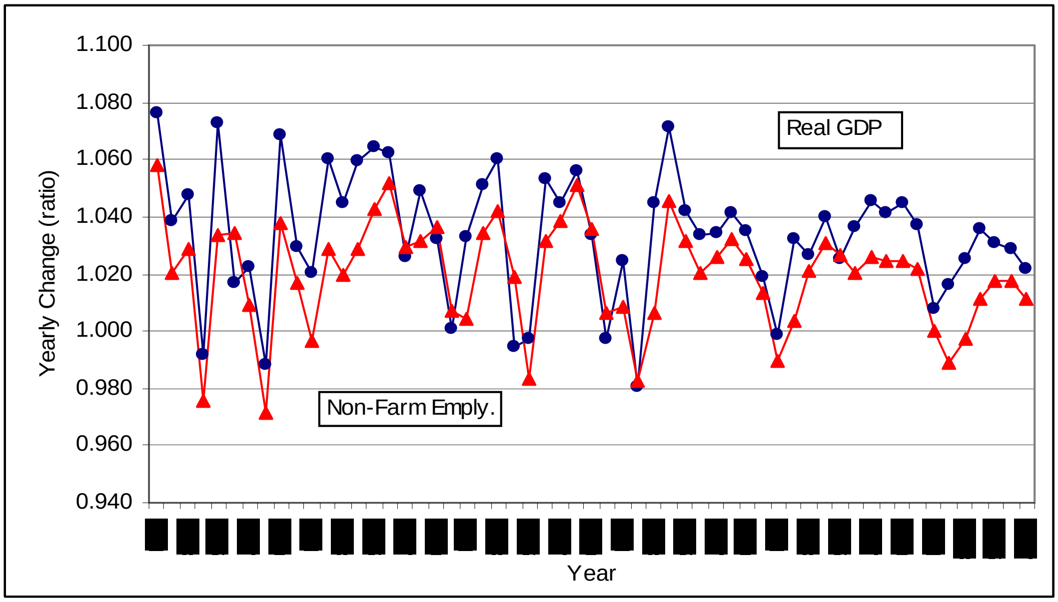
Figure 4. Yearly Change In Nominal and Real Passenger Economic Cost per Passenger-Mile



Source: Nominal Eco. Cost from data sources listed in Figure 3. Real Eco. Cost is Nominal Eco. Cost divided by the Consumer Price Index, CPI-U, U.S. Department of Commerce, Bureau of Labor Statistics. (http:data.bls.gov/cgi-bin/surveymost)

The Economy: There are a number of variables that have been used in the past to reflect overall economic conditions that might affect the demand for air travel. Published forecasts included Gross Domestic Product (Federal Aviation Administration, or FAA), and Disposable Personal Income (Civil Aeronautics Board, or CAB). Also studied at the CAB were Personal Consumption Expenditures and various measures of employment. Virtually all released forecasts used data in inflation-adjusted terms. However, as noted in Price, above, the use of variables in real terms may not reflect actual consumer experience. Consequently, the effect of the economy is examined in both real and nominal terms for those variables expressed in monetary terms. In addition, a non-monetary variable, non-farm employment, has been added as a surrogate for the selected monetary variables. As shown below, the change year-to-year in real GDP and Non-Farm Employment closely follow one another.

Figure 5. Yearly Change in Real Gross Domestic Product and Non-Farm Employment



Source: U.S. Department of Commerce, Bureau of Economic Analysis (http://www.bea.gov/national/index.htm#glp)

Other Variables: As shown in Figure 1, the early years of air transportation were characterized by very high levels of growth. The CAB attempted to offset the effect of this relative newness of air travel by employing a time trend in its forecasts. This really extraordinary growth of air travel seemed to weaken in the late 1960's. To test the continued validity of this approach, a "time" variable was employed in some model formulations for the period 1951-1970.[2]

The terrorist attacks in 2001 clearly impacted domestic air travel in 2001 and 2002, as again indicated by Figure 1. Travel seemed to recover by 2003, albeit at a much reduced fare level. A dummy variable was used to measure the effect of the terrorist attack on demand and price in 2001 and 2002.

The effect of changes in consumer confidence in current conditions may differ from overall changes in actual economic conditions. While this variable was tested as an independent variable in each of the subgroups described in Part A, it generally was also collinear with other measures of the economy, added little to the overall predictability of the equations, and is not reported here.

The general effect of all variables tested is shown in the following section.

Part D. Results and Conclusions

It is assumed that the demand for a product is a function of price and wealth, with the presumption there is a need or want for the product. Here our "product" is RPM's, with the price in economic cost per RPM, or EcoCst. Wealth is measured by Gross Domestic Product (GDP), Disposable Person Income (DPI), and the surrogate non-price variable, Non-Farm Employment (NFE). Variables may be presented in nominal or real terms, and may be on a per capita basis.

The analysis below will provide a general overview of models using selected variables over the whole time period studied, 1951-2007, and three subgroups, 1951-1969, 1970-1987, and 1988-2007. While two intermediate model steps are presented, the model comparisons default to logarithmic first differences to remove autocorrelation and to gain the benefits of the multiplicative model form. A general summary of the change in the price elasticity of demand will conclude the paper.

Development of the Model Form

The Civil Aeronautics Board, as the regulator of both price and markets served, made yearly and longer-term forecasts of RPM's, generally in per capita terms and using time series data. The CAB's forecast model employed a "time" variable to reflect an expected reduction in growth as time passed, and was in inflation-adjusted terms. Yield was expressed as economic yield, e.g. the cost-per-mile the passenger paid, not the yield the carrier received. While not discussed in great detail in their published forecasts, the CAB's model was the third step in their examination of traffic growth. That sequence is followed below, with time-series regressions using actual data progressing to regressions using first differences of the variables, to the final step of using the logarithm of those first differences to change the model form from an additive to multiplicative type. The time variable has been dropped in the analysis below.

Additive Time-Series Models Using Actual Data 1950-2007

Below are the results of three industry models for the period 1950-2007 using actual data, one employing the CAB's formulation in per capita terms (Cap), one using GDP, and one using NFE. All price-related variables are in real terms, designated by a small (r). Decimals are shown to three decimal points. Only one of the three models has the correct sign for the price variable.

RPM/Cap= 1599.61 + 21.522rDPI/Cap + 11.175rEcoCst. R^2adj = .972, DW = 0.300
RPM= -121084 + 6334.19rGDP - 350.042rEcoCst. R^2adj = .992, DW = 0.352
RPM= -659128 + 8.183NFE + 10853.1rEcoCst. R^2adj =.984, DW = .422

All three models, and generally all aviation demand models employing actual data, are invalidated by a poor measure of serial correlation, as measured by the Durbin-Watson test. The three models also demonstrate the rationale behind using beta coefficients to analyize and remove the effect of different units of measurement. It is unreasonable to expect such massive changes in coefficients for price.

Many papers estimate the price elasticity of demand using cross-sectional market-pair data. In these models the coefficient of actual market-pair prices is presumed to be the price elasticity of demand. However, since there is no comparison of a change in price in a particular market to a change in demand in that market, what is really being estimated is the coefficient of the *level* of price over all market-pairs, to the *level* of demand over all market-pairs, not price elasticity. In effect, the delta Q and delta P from the equation for price elasticity are missing. More telling, the absolute size of other variables generally used (market-pair income, squared distance) in models employing actual data tend to swamp the fare variable. It would be interesting to see the model results if beta coefficients were employed as a test of each variable's contribution.

One alternative method of removing first-order serial correlation (and remove scalar effects) is by regressing the *change* in the variables from year-to-year, rather than the *level* of the variables. Succeeding models are all of this form. It should also be noted that the predictive ability of the different model forms is not fairly represented by a comparison of the coefficient of correlation. In the first-difference models you are predicting the *change* from one period to the next, in most other model forms you are predicting the *level* of the variable. A forecast error seemingly small in models estimating the level of the data may be very much larger than the forecast error in models estimating the change in the level of the dependent variable, particularly when the forecast change is restated to estimate the level.

<u>Additive Time-Series Models Using the First Differences (Ratio) of the Variables 1951-2007</u>
(Where d = delta, r = price deflated (real))

Rather than the level of the dependent variable, the model form is now structured to predict the *change* in the dependent variable from period to period. This has the interesting result of allowing the coefficients of the independent variables to be directly read as elasticities -- a change in the dependent variable is directly estimated by the change in the independent variable times its coefficient. The independent variable results are additive. Economic cost in real and nominal terms was used with the non-price variable NFE for comparative purposes. A dummy variable was added for the years 2001 and 2002 to reflect the fall in traffic after the terrorist attacks in 2001. The Students t-test results are shown below the variable coefficient, to two decimal places. The data series is reduced by one observation, now 1951-2007.

dRPM/Cap= 0.924 + 0.861drDPI/Cap - 0.741drEcoCst - 0.168Du1-02. R^2adj= .371, DW= 1.091
(2.18) (2.47) (-3.98) (-3.82)
dRPM= 0.256 + 1.492drGDP - 0.726drEcoCst - 0.144Du1-02. R^2adj= .530, DW= 1.103
(0.66) (4.63) (-4.29) (-3.51)
dRPM= -0.014 + 1.739dNFE - 0.687drEcoCst - 0.129Du1-02. R^2adj= .485, DW= 0.891
(-0.03) (4.38) (3.96) (-3.02)
dRPM= -0.127 + 1.762dNFE - 0.572dEcoCst - 0.130Du1-02. R^2adj= .519, DW= 0.912
(-0.30) (4.61) (-4.50) (-3.19)

The CAB's old formulation of RPM's and DPI on a per capita basis did not age well. Both GDP and NFE results were significantly higher. Note the change in the intercept and the coefficient for EcoCst for the two equations using NFE. Both reflect the effect of expressing price in real terms in the one and nominal terms in the other. Results using GDP and Personal Consumption Expenditures on a per capita basis had significantly lower adjusted R^2 and are not reported. The cost elasticity coefficients for all model formulations, however, were all more positive than -1.0.

The models above all indicate that the overall price elasticity of demand for air transportation is less than minus one, or inelastic. However, this result may be due to the additive model formulation. Below the models are transformed to a multiplicative model form by taking the logarithms of all variables, and breaking the data series into three discrete time intervals.

Results of the Selected Model Form -- Change Expressed as Linear-in-the-Logarithms

<u>Multiplicative Models Using the Logarithmic First Differences of the Variables, 1951-2007</u>
(Where d = delta, l = log, r = price deflated (real))

dlRPM= 0.008 + 1.423dlrGDP - 0.668dlrEcoCst - 0.060Du1-02. R^2adj= 0.524, D-W= 1.146
(1.66) (4.95) (-4.71) (-3.88)
dlRPM= 0.010 + 1.023dlGDP - 0.747dlEcoCst - 0.066Du1-02. R^2adj= 0.506, D-W= 1.198
(1.35) (4.28) (-6.23) (-4.20)
dlRPM= 0.015 + 1.597dlNFE - 0.639dlrEcoCst - 0.055Du1-02. R^2adj = 0.499, D-W = 0.929
(3.65) (4.55) (-4.36) (-3.36)
dlRPM= 0.025 + 1.620dlNFE - 0.576dlEcoCst - 0.056Du1-02. R^2adj= 0.539, D-W= 0.957
(6.03) (4.83) (-5.02) (-3.62)

Here again all price elasticity estimates are well under -1.0. All models improve slightly, with limited change to the price coefficient between the additive and multiplicative model forms. Note that the economic variable GDP has a significant increase to its coefficient when expressed in real (e.g. deflated) terms, a reduction not shown with the economic variable NFE.

With the reduction in average growth rates over the period 1951-2007 (Figure 1), it follows that there could be significant changes in the estimates of price elasticity for the same periods. Regression estimates of the three periods shown in Figure 1, 1951-1969, 1970-1987, and 1988-2007 using the same variables are provided below.

<u>Multiplicative Models Using the Logarithmic First Differences of the Variables, 1951-1969</u>

dlRPM= 0.025 + 1.135dlrGDP - 1.003dlrEcoCst. R^2adj= 0.552, D-W= 1.439
(2.93) (2.64) (-3.38)
dlRPM= 0.021) + 1.202dlGDP - 0.805dlEcoCst. R^2adj= 0.541, D-W= 1.465
(2.07) (3.48) (-2.40)
dlRPM= 0.034 + 1.248dlNFE - 0.767dlrEcoCst. R^2adj = 0.496, D-W = 1.370
(5.04) (2.10) (-2.09)
dlRPM= 0.040 + 1.547dlNFE - 0.617dlEcoCst. R^2adj= 0.442, D-W= 1.251
(5.38) (2.67) (-1.54)
dlRPM= 0.043 + 1.501dlNFE - 1.017dlYield. R^2adj= 0.572, D-W= 1.254
(5.38) (2.67) (-1.54)

In this first period, price elasticity estimates range from -1.02 (dlYield) to -0.617 (dlEcoCst). The nominal yield and dlNFE equation has the highest R^2, with an elasticity greater than -1.0! This likely reflects the reduction in taxes in the late 1950's, which is also clearly identifiable in the difference between charged yield and economic yield over this time period. The constant term indicates a relatively high average growth, which is supported by Figure 1.

<u>Multiplicative Models Using the Logarithmic First Differences of the Variables, 1970-1987</u>

dlRPM= 0.012 + 1.006dlrGDP - 0.456dlrEcoCst. R^2adj= 0.507, D-W= 2.033
(2.13) (3.03) (-3.03)
dlRPM= 0.013 + 0.646dlGDP - 0.487dlEcoCst. R^2adj= 0.414, D-W= 1.868
(2.93) (2.64) (-3.38)
dlRPM= 0.011 + 1.557dlNFE - 0.485dlrEcoCst. R^2adj= 0.641, D-W= 1.715
(2.43) (4.26) (-3.78)
dlRPM= 0.024 + 1.447dlNFE - 0.399dlEcoCst. R^2adj= 0.685, D-W= 1.836
(5.20) (4.22) (-4.30)
dlRPM= 0.023 + 1.540dlNFE - 0.428dlYield. R^2adj= 0.781, D-W= 1.884
(6.12) (5.39) (-5.74)

In this second period price elasticity has fallen below -1.0 for all model estimates, ranging from -0.487 to -0.399. Both nominal and real NFE equations perform better than the equations using real or nominal GDP.[3] There is little change to the constant term in the GDP equations, though the coefficient for GDP increased significantly with the use of "real" data. Actual carrier yield, added as a test comparison to economic cost, again provided the highest adjusted R^2. Does this mean passengers focused on carrier transport cost more than on economic cost? Or that the difference between carrier yield and economic yield was not yet great enough?

<u>Multiplicative Models Using the Logarithmic First Differences of the Variables, 1988-2007</u>

dlRPM= -0.007 + 1.650dlrGDP - 0.407dlrEcoCst - 0.034Du1-02. R^2adj= 0.652, D-W= 1.670
(-1.58) (3.52) (-2.89) (-3.58)
dlRPM= -0.008 + 1.647dlrGDP - 0.386dlrYield - 0.034Du1-02. R^2adj= 0.600, D-W= 1.521
(-1.04) (3.26) (-2.28) (-3.15)
dlRPM= -0.005 + 1.079dlGDP - 0.479dlEcoCst - 0.042Du1-02. R^2adj= 0.556, D-W= 1.714
(-0.35) (1.80) (-3.05) (-3.61)
dlRPM= 0.010 + 0.683dlNFE - 0.394dlrEcoCst - 0.041Du1-02. R^2adj= 0.430, D-W= 1.606
(1.84) (1.15) (-2.13) (-3.36)
dlRPM= 0.016 + 0.726dlNFE - 0.482dlEcoCst - 0.046Du1-02. R^2adj= 0.521, D-W= 1.887
(3.36) (1.34) (-2.91) (-4.00)

This last period contains a "dummy" variable for the years 2001-2002 to reflect the significant fall in traffic after the terrorist attacks. For comparative purposes a real yield variable was substituted for real economic cost in the second equation. While the variable coefficients showed little change, the adjusted R^2 did fall some five points, differing from the first two tested sub-periods. This is likely the result of the significant increase in non-fare charges included in the ticket price. See Figure 3.

<u>Multiplicative Model Estimates For the Period 1951-1991 and 1992-2007</u>
Several other time periods could be selected as interval groupings, based on visual trends exhibited in Table 1. Below is the long-term period of decline in growth from 1951-1991, followed by the flat period 1992-2007 (*). One real formulation and one nominal formulation are shown for each period. None show an elasticity approaching -1.0, with both non-price independent variables lacking statistical significance in the latter period.

dlRPM= 0.012 + 1.427dlrGDP - 0.689dlrEcoCst. R^2adj= 0.499, D-W= 1.214
(2.06) (4.55) (-4.03)
dlRPM= 0.029 + 1.656dlNFE - 0.600dlEcoCst. R^2adj= 0.557, D-W= 1.090
(6.14) (4.623) (-4.761)
*dlRPM= 0.003 + 1.119dlrGDP - 0.360dlrEcoCst - 0.039Du1-02. R^2adj= 0.714, D-W= 1.997
(0.27) (1.54) (-2.89) (-2.58)
*dlRPM= 0.025 - 0.241dlNFE - 0.419dlEcoCst - 0.055Du1-02. R^2adj= 0.685, D-W= 2.366
(4.90) (-0.41) (-2.83) (-5.14)

It should be noted that the estimates of demand price elasticity varied less than the constant or economic variables when expressed in real or nominal terms. The deflating effect of using data in "real" terms seems to increase either the intercept or the economic variable value to compensate for that reduction. This leads one to question whether economic variables expressed in dollar terms should be inflation-adjusted. The models here presented do not generally support adjusting to constant-dollar levels.

The table below compares the coefficients for economic cost for the linear-in-the-logarithms models developed above over the entire period 1951-2007, and for each of the selected sub-periods.

Table 1. Selected Price Elasticity Estimates by Time Interval; Multiplicative Linear-in-the-Logarithms First-Difference Model Form

	Using Real Data				Using Nominal Data			
Period	GDP, Econ. Yield	Adj. R^2	NFE, Econ. Yield	Adj. R^2	GDP, Econ. Yield	Adj. R^2	NFE, Econ. Yield	Adj. R^2
1951-1969	-1.003	0.552	-0.767	0.496	-0.805	0.541	-0.617	0.442
1970-1987	-0.456	0.507	-0.485	0.641	-0.487	0.414	-0.399	0.685
1988-2007*	-0.407	0.652	-0.394	0.430	-0.479	0.558	-0.482	0.521
1951-2007*	-0.668	0.524	-0.639	0.499	-0.747	0.506	-0.576	0.539

* Includes Dummy 2001-02

When the Civil Aeronautics Board regulated airline fares under the aegis of the *Domestic Passenger Fare Investigation*, its rate setting adjustments assumed a -0.6 fare elasticity for the trunkline industry in nominal terms. InterVistas Consulting, Inc., in a recent compendium of studies done for the International Air Transport Organization that included time series and cross-section studies, estimated the overall national level price elasticity in the region of -0.8.[4] Gillen, *et al*, in a study for the Canadian Department of Finance, estimated the median time series price elasticity of 136 studies at -0.85.[5] Both studies note the extensive use of the DOT's *Origin-Destination Survey of Airline Passenger Traffic.*

Summary

It is clear that there is a marked reduction in demand price elasticity from the first period ending in 1969 to the last sub-period ending in 2007 if inflation-adjusted data are used. Of the nominal data models, those employing GDP exhibit the same continuous decline as shown in the real model formulations. The models employing NFE and nominal economic yield show a marked fall in elasticity in the second period, and a small increase in the third. However, elasticity estimates for both the second and third periods were below the first period and average.

The shown decline in price elasticity by subgroup over time, with intermediate price elasticity coefficients at a significantly lower level than summary estimates of price elasticity for the whole period 1950-2007, is not inconsistent with the product life-cycle theory. Strong initial growth of a new product gradually tapers off to a more generalized reduced long-term growth. This clearly has happened in the airline industry with regard to growth, why shouldn't the similar effect apply to the price elasticity of demand?

Endnotes

1. Beta coefficients are the coefficients of variables in multiple regression equations that have been standardized such that they have a variance of 1 (by subtracting the mean and dividing by the standard deviation.) The standardized coefficients represent the change in the dependent variable resulting from a change in the independent variable of one standard deviation. For our selected model formulation, measures of the economy are by far the most important. Use of beta coefficients does not correct for serial correlation. Data are for the years 1950-2007.

RPM= -5.92724E-06 + 0.9865rGDP - 0.0103rEcoCst. R^2adj = .992, DW = 0.352
RPM= -1.36822E-05 + 1.0349NFE - 0.0486EcoCst. R^2adj =.977, DW = 0.176

2. The CAB model formulation employed an increasing value for "time", or passenger acceptance of air travel. Here the change in the log of the increase in the calendar year from one year to the next is used as the "time" variable for the period 1951-1969.

dlRPM/Cap= 0.0608 + 1.171dlrGDP/Cap - 0.9815drEcoCst - 0.0361LogYear. R^2adj= .684,
(4.37) (3.25) (-3.84) (-2.70)

3. A Dummy variable was also tested for the recession years 1980-1982. NFE fell only in 1982, while real GDP fell in 1980 and 1982. Significant increases in R^2 adj. were shown for models employing NFE, while all models had demand elasticity coefficients less than -0.33.

4. In this paper most of the discussion of price elasticity is directed to models that separate market-pair groupings by distance, see pages ii, iii, v, 6, and 31. The -0.8 national elasticity estimate is from page iii.

5. A number of histograms are presented in this paper, separating elasticity estimates by distance interval and trip purpose. Of the 136 estimates using time series data, the median elasticity estimate was -0.847. See Section 4, page 14.

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