

## Appendix

### A Long-Run Cost Function For the Local Service Airline Industry: An Experiment in Non-Linear Estimation

by

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This Appendix describes the construction of the variables used in the equations whose estimation is described in the body of the paper. The source of the data is the CAB's Report of Financial and Operating Statistics for Certificated Air Carriers [5], otherwise known as "Form 41." The portions of Form 41 that were used in variable construction are filed quarterly by each carrier, with the exception of Schedule P-41, "Taxes," which is filed annually. Copies of the complete Form 41 are available only in the Public Records Room of the CAB in Washington, but certain data from Form 41 are published by the CAB in summary form, for example, in [1], [2], [3], and [4] and in a number of trade publications, including Aviation Week and Flight Magazine.

#### Dependent Variable

The dependent variable (COST)<sup>1</sup> is "Total Operating Expenses" (P-1.2, 7199)<sup>2</sup> less "Depreciation and Amortization Expenses" (P-1.2, 7000).

"Depreciation and Amortization Expenses" includes as major categories depreciation expenses for flight equipment, for maintenance equipment

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<sup>1</sup>The capital letters in parentheses following a variable name are the acronym that is used to designate the variable in the text except where explicitly stated otherwise.

<sup>2</sup>The first number in the parentheses is the schedule of Form 41 on which the data appear. The second number is the relevant account on that schedule. For the official CAB definition of what each account is to include see [6].

and hangars, and for general ground property (see Schedule P-3 for a breakdown by categories). The latter two items were considered to be legitimate items of fixed cost and were subtracted from "Total Operating Expenses" for that reason. There is general agreement, however, that the depreciation expenses for flight equipment reported by the carriers do not reflect the flow of services provided by aircraft in any meaningful sense. For this reason, they, too, were subtracted from "Total Operating Expenses."<sup>3</sup> Interest expenses were not subtracted from "Total Operating Expenses" since they are not included in this account, but are found in Accounts 8187.1-8187.3 (Schedule P-3), which appear on Schedule P-1.2 consolidated into the general account "Nonoperating Income and Expense, Net" (8100). Since the stock of pilots and copilots was used as a measure of the flow of services of the fixed factor, wages of pilots and copilots (P-10) were also subtracted as a fixed cost. Fuel expenses (P-5.2, 5145.1) (including an estimate of fuel taxes) were subtracted from "Total Operating Expenses" since separate fuel expense equations were estimated.

#### Independent Variables

Price of Fuel [Piston (PFP) and Turbine (PFT)]: These variables were constructed by dividing "Fuel Expenses" (P-5.2, 5145.1) by "Gallons of Fuel Issued" (T-3, 9992) and adding an estimate of the fuel tax per gallon of fuel. According to this definition, a fuel price was undefined for a

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<sup>3</sup>This decision was made only after extensive study of the CAB accounts and after conversations with a number of CAB staff members. We are unsure just how much the fact that our results may differ from those of others may be due to our decision to exclude aircraft depreciation expenses as either a fixed or a variable cost. Investigation of this point is currently under way.

carrier unless that carrier actually used the particular type of fuel during the accounting period.

The estimate of the fuel tax per gallon was obtained by allocating "Fuel Taxes" (P-41, filed annually) between piston and turbine fuel and dividing the result by the number of gallons of each type of fuel issued during the year. This assumes that any change in the fuel tax occurred on the first day of the year, but the assumption was unavoidable.

There is a two cent per gallon Federal tax on piston fuel but no tax on turbine fuel. The Federal tax rates have not changed since 1951. The states differ in their policies as to whether turbine fuel is taxed and also in the rates of tax they apply to aviation fuels. Their rates have changed more frequently than the Federal tax rate.

Since tax rates differ between states, a carrier changing its pattern of operations becomes subject to a different effective tax rate. State fuel taxes were allocated on the basis of the areas served by each carrier using data from the table "State and Federal Aviation Gasoline and Jet Fuel Taxes (cents per gallon): 1919-1964" ([28], 1965, ed., pp. 518-19). Certain somewhat arbitrary assumptions were unavoidable in the course of this allocation of state fuel taxes, but we feel that no serious biases in the fuel price variable were introduced as a result.

Price of Labor Net of Pilots and Copilots (PLNP): Payroll data by class of employee are reported on Schedule P-10; but, although Schedule P-10 is filed quarterly, the wage bill figures on it are stated in annual rates, therefore they were divided by four. "Payroll taxes" (P-41) are reported only annually, and therefore must be prorated. This was done by weighting them by the quarterly wage bill. The variable PLNP

was obtained by dividing the net quarterly wage bill including prorated payroll taxes (the quarterly wage bill for pilots and copilots was subtracted) by the net number of employees for the quarter (P-10) (i.e., total employees less pilots and copilots).

Price of Pilots and Copilots (PPILOT): The quarterly payroll for pilots and copilots (P-10) was divided by the number of pilots and copilots (P-10). It was not possible to include payroll taxes in the quarterly pilot and copilot payroll since tax payments by employee class are not recorded.

Fuel Usage [Piston (GFP) and Turbine (GFT)]: The data for these variables were obtained from Schedule T-3 (999.1) which lists gallons of fuel issued by aircraft type. GFP is the total gallons of fuel used by piston-engine aircraft and GFT is the corresponding total for turbine aircraft. It was assumed that all fuel issued during a quarter was used during that quarter.

Aircraft Miles [ACM(i), where i Represents the Aircraft Group, and ACMT]: ACM(i) consists of "Total Aircraft Miles" (T-3, 9597), reported by aircraft type and aggregated into aircraft groups according to the scheme outlined in the text. It includes miles flown in both scheduled and unscheduled service. Total Aircraft Miles (ACMT) is the unweighted sum of ACMA, ACMB, ACMC, and ACMD.

Aircraft Departures [ACD(i)]: This consists of total departures performed by aircraft type aggregated by aircraft group. It is the sum of "Total Departures Performed in Scheduled Service" (T-4) and "Total Departures Performed in Nonscheduled Revenue Flights" (T-3, 8684).

Stations Served (STA): This variable was obtained from a count of

the stations served listed on Schedule T-4.

Stock of Pilots and Copilots (PCP): The data for this variable was obtained from Schedule P-10, "Payroll".

#### REFERENCES

- [1] U. S. Civil Aeronautics Board, Costs and Statistics Division, Bureau of Accounts and Statistics. Aircraft Operating Cost and Performance Report for Calendar Years 1965 and 1966. Washington, 1967.
- [2] \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, Handbook of Airline Statistics. (Various editions.) Washington.
- [3] \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, Monthly Report of Air Carrier Traffic Statistics. (Various issues). Washington.
- [4] \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, Quarterly Report of Air Carrier Financial Statistics. (Various issues). Washington.
- [5] \_\_\_\_\_, Report of Financial and Operating Statistics for Certificated Air Carriers, Form 41. (First quarter of 1968 through fourth quarter of 1966). Washington.
- [6] \_\_\_\_\_, Uniform System of Accounts and Reports for Certificated Air Carriers in Accordance with Section 407 of the Federal Aviation Act. Washington, 1961. (looseleaf)