ECONOMETRIC ANALYSIS OF AIRLIFT PASSENGER DEMAND

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Abstracts: Traditional airlift passenger demand forecast models are not sufficient in view of econometrics which has been developing her ways of investigating economic phenomenon since 1970s.

This research applies this method to build three econometric models of tourism, visiting relatives, and business purposes of Americans to Korea respectively.

From these models, it is possible to get some conclusions and policy implication. To promote American travelers to Korea it is needed that, for the tourists, authorities focus on to the tour organizers rather than individual tourist and that, for Korean ethnics, authorities prepare package program of home coming.

## I.GENERAL REVIEW OF THE AIRLINE DEMAND FORECAST MODELS

This research is purposed to review current airlift demand forecast models and to refine in accordance with the analysis methods of econometrics.

Kanafani(1983) categorized current models into two ways of macroanalysis and microanalysis models in reference to the dichotomous analysis methods of the economics as macroeconomics and microeconomics respectively. Macroanalysis methods includes both of the time series models and variable elasticity models as shown <Figure 1 and 2>.

Simple time series model developed by Watkins(1972) is as follows.

$$\triangle \log RPM / capita = 0.736 - 1.34980 \triangle \log FPM$$
$$+ 1.088 \triangle \log DPI / capita - 0.395 \log T --- (1)$$
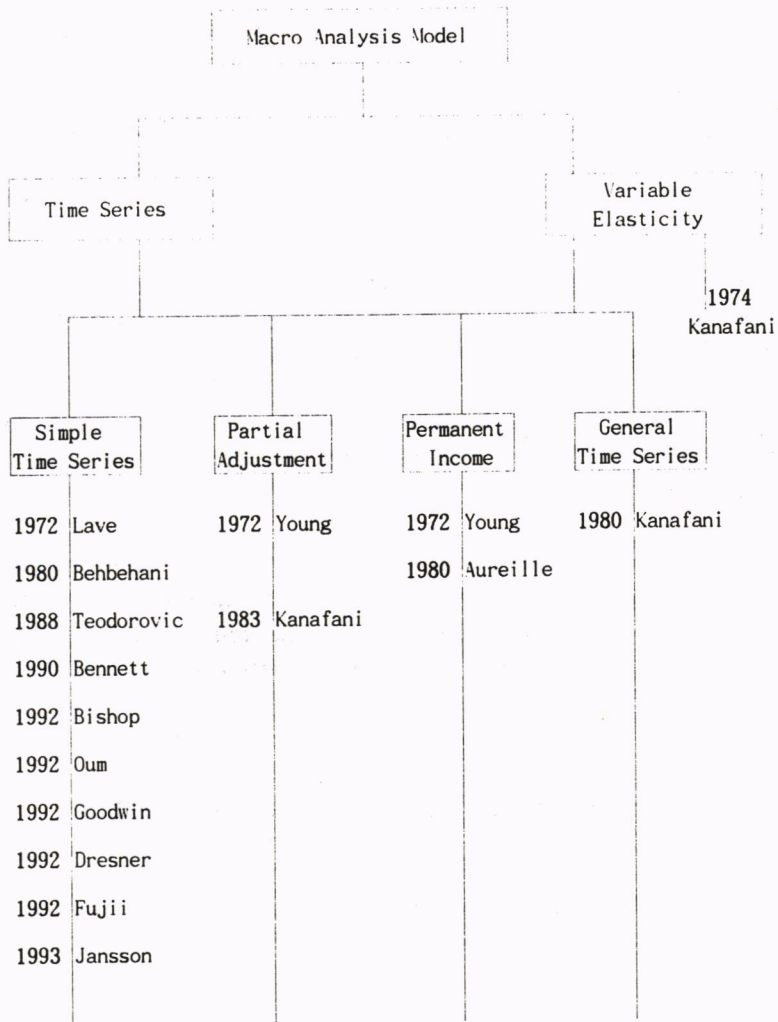
〈 Figure 1 〉 Macro analysis models

During the period of 1950~60s, airlines in U.S.A. utilized various type of aircrafts but did not introduce any type of jet engined aircrafts yet. Therefore, her speeds were different and "T" could effect to demand. But, now, airlines utilize jet aircrafts and this variable should be reconsidered to be whether it is necessary.

In variable elasticity model, elasticity means the ratio between the variating rates of the numerator (dependent variable) and of the denominator (independent variable). Following is the A.T.A (1969) model.

$$\log (REV) = -1.830 + 2.023 \log (PCE) \text{————————} (2)$$

(REV:number of revenue passengers, PCE:personal consumption expenditure)
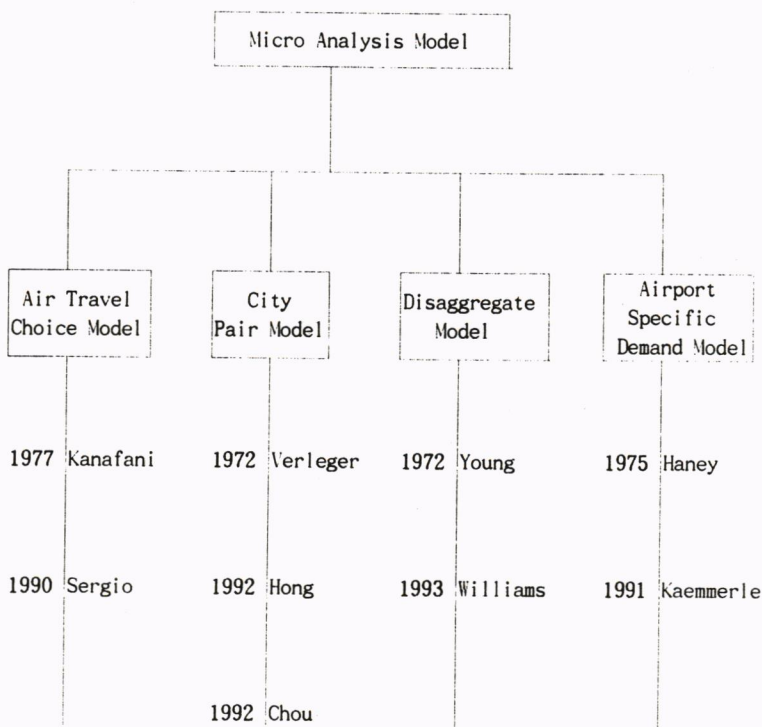
In consideration of time, the statistical observation usually takes as one year, because it is essential that the economic datas are available on an annual basis.

Current demands would be the results of the foregone years as Young (1972) model for the U.S. domestic passenger.

$$\log T_t = -1.98 + 1.04 \log I_t - 1.591 \log F_t - 0.52 \log H_t + 0.671 \log T_{t-1} \text{————————————} (3)$$

(T : average flying distance/aircraft speed, H : average flying time
 I : disposable income per capita, F : total revenue/passengers)

This model so introduces T into dependent and independent variable that some autocorrelations arise to devalue statistical significances.


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                        ┌─────────────────────┐
                        │ Micro Analysis Model│
                        └──────────┬──────────┘
        ┌──────────────┬───────────┼──────────────┐
 ┌───────────┐  ┌───────────┐ ┌───────────┐ ┌───────────┐
 │Air Travel │  │   City    │ │Disaggregate│ │ Airport  │
 │Choice Model│  │Pair Model │ │   Model    │ │ Specific │
 └───────────┘  └───────────┘ └───────────┘ │Demand Model│
                                            └───────────┘

 1977 Kanafani   1972 Verleger  1972 Young   1975 Haney

 1990 Sergio     1992 Hong      1993 Williams 1991 Kaemmerle

                 1992 Chou
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< Figure 2 > Micro analysis models

The objective period of this research is between 1969 and 1990, before ASIANA airline was inaugurated transpacific routes. Econometric models will be built for these 3 categories.

To build the econometric demand models of American travelers to Korea, demands are divided into two categories of tourism and of non-tourism purpose. And non-tourism purpose trips are also divided into visitors of relatives and other (including business purpose.)

Independent variables are final consumption expenditures per capita (Table A-3), Transaction between Korea and U.S.A. (Table A-6), air fare (Table A-5), and GDP per capita (Table A-4) of appendix.

In due to decreasing air fare and increasing income, American travelers to Korea increased 14.2% in average annually.

2. ECONOMETRIC MODEL BUILDING

2.1 American Tourists to Korea

$$\ln T_t = 1.321156 \ln d_t - 1.028466 \ln f_{t-1} + 0.536099 \ln T_{t-1} \quad \text{------------(4)}$$
$$\quad\quad (2.403056) \quad\quad\quad (-1.243644) \quad\quad\quad (3.159584)$$

( ) t statistical value of 95 % significance level.

$$R^2 = 0.97, \quad \bar{R}^2 = 0.96, \quad D. W. = 1.94$$

(T_t : American tourists, d_t : Final expenditure per capita, f_{t-1} : fare of previous year)

⟨ Table 1.⟩   **Kolmogorov-Smirnov Evaluation**

Range	Number of Observation (O_i)	Accumulated Frequency $(C\,O_i)$	Expected Frequency (E_i)	Accumulated Frequency $(C\,E_i)$	Difference $(d=C_iC_i - C_iE_i)$
$-\infty \sim -1.0$	0	0	2.2679	0.1587	-0.1587
$-1.0 \sim -0.5$	0	0	2.5463	0.3085	-0.3085
$-0.5 \sim 0$	0.41	0.41	3.2558	0.5	-0.09
$0 \sim 0.5$	1.0	1.0	3.2558	0.6915	0.3085
$0.5 \sim 1.0$	1.0	1.0	2.5463	0.8413	0.1587
$1.0 \sim \infty$	1.0	1.0	2.6975	1.0	0
total	17		17		

$$\max| \, d \, | = \max_t \left| \sum_{i=0}^{t} \frac{O_i}{n} - \sum_{i=0}^{t} \frac{E_i}{n} \right| = 0.3085$$

$0.3085 \langle 0.318$, therefore, null hypothsis is adopted.

2.2 American Visitors to Korea

$$\ln B_t = 0.420802 \ln g_t + 0.764301 \ln m_t \text{————————————(5)}$$
$$(3.004489) \qquad (5.491212)$$

$R^2 = 0.9442, \quad \bar{R}^2 = 0.9330, \quad D.W. = 1.97, \quad \rho = 0.597 \text{ (Cochran - Orcutt)}$

(B_t : business purpose visitors, g_t : real GDP per capita in America
m_t : transactions between two countries)

⟨ Table 2.⟩ **Kolmogorov-Smirno Evaluation**

Range	Number of Observation (O_i)	Accumulated Frequency $(C\,O_i)$	Expected Frequency (E_i)	Accumulated Frequency $(C\,E_i)$	Difference $(d=C_iC_i - C_iE_i)$
$-\infty \sim -1.0$	0	0	2.2218	0.1578	-0.1578
$-1.0 \sim -0.5$	2	0.1428	2.0958	0.3085	-0.1657
$-0.5 \sim 0$	2	0.2857	2.681	0.5	-0.0228
$0 \sim 0.5$	6	0.7142	2.681	0.6915	0.0227
$0.5 \sim 1.0$	2	0.8571	2.0958	0.8413	0.0158
$1.0 \sim \infty$	2	1.0	2.2218	1.0	0.0
total	14		13.9972		

max $|d| = 0.1657 < 0.349$, therefore, null hypothesis is adopted.

2.3.Korean Ethnics (of America) Visitors

$$\ln V_t = 0.560291 + 0.516563 \ln d_t - 4.168766 \ln f_{t\ 1} - 3.461288 \ln f_{t\ 2}$$
$$(0.802) \qquad (7.584) \qquad (-3.180) \qquad (-2.917)$$
$$\text{————————————(6)}$$

$R^2 = 0.8787, \quad \bar{R}^2 = 0.8374, \quad D.W. = 1.26, \quad \rho = 1.17.$

The reason why statistical values are not so good is that, when Korean ethnics (of America) visit their motherland to visit relatives, they are used to buy any diluted tickets from the normal fare.

3. POLICY IMPLICATIONS

Americans' behavior of travel is rational in view of economy referring statistical values of three models. In tourism purpose travel model, demand elasticities both of income and fare are near unitary (1.32 and -1.03 respectively) mean that they consume travel as an usual goods rather than luxury.

They respond fares of previous year not currents year and also the tour fashions of previous year. It means that Americans begin to plan several years before and pay tour fees to the organizers two years before at least.

American visitors for the purpose of business respond real GDP per capita rather than final consumption expenditures per capita, and also real transactions between two contries.

Korean ethnics of America desire to visit their relatives in motherland regardless of their level of income (demand elasticity of income, 0.56.) But they could materialize their desire depend upon highly the level of fares.

And they begin to plan several years earlier than American tourists.

Upon these conclusions, policy implications are drawn as follows.

First, to promote foreign tourists to travel to Korea, authorities focus their activities on to the tour organizers of America rather than the individual traveler.

The target is to the middle level income or above group. Public relations activities including advertise are maintained continuously with long-term programs.

And, because Americans refer those tourism pattern that tourists have swarmed into, authorities keep the bondages with the persons who already visited Korea.

Second, to materialize the desire of Korean ethincs of America, authorities prepare package program of home-coming tour several years prior to their trips.

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APPENDIX A

⟨Table A-1⟩ Americans to Korea(Tourism Purpose)

Year	Tourists			Others		Total
	Persons	Occupancy rate(%)	Rate (%)	Persons	Rate (%)	
1970	13243	23.93	14.96	42109	10.56	55352
1971	14795	25.51	11.72	43208	2.61	58003
1972	17845	28.07	.20.62	45733	5.84	63578
1973	23892	30.80	33.89	53680	17.38	77572
1974	27016	33.51	13.08	53605	-0.14	80621
1975	28737	29.50	6.37	68685	28.13	97422
1976	32013	31.32	11.40	70186	2.19	102199
1977	37465	32.95	17.03	76245	8.63	113710
1978	42420	35.94	13.23	75619	-0.82	118039
1979	55937	43.92	31.87	71418	-5.56	127355
1980	53295	43.90	-4.72	68109	-4.63	121404
1981	58475	44.84	9.72	71927	5.61	130402
1982	67089	44.36	14.73	84160	17.01	151249
1983	80776	45.77	20.40	95712	13.73	176488
1984	89894	42.21	11.29	123092	28.61	212986
1985	82388	34.41	-8.35	157035	27.58	239423
1986	112069	39.38	36.03	175502	9.85	284571
1987	136412	41.80	21.72	189918	8.21	326330
1988	122604	35.30	-10.12	224677	18.30	347281
1989	108454	34.20	-11.54	208679	-7.12	317133
1990	104756	32.19	-3.41	220632	5.73	325388

⟨Source : Korea Tourism Promotion Association,

Foreigners to Korea (Monthly Report)⟩

⟨Table A-2⟩ American Travelers to Korea (Visiting Relatives)

Year	Visiting Relatives	Business		Others	Total
		Commercial	Official		
1976	1682	11785	42303	14416	70186
1977	1262	20860	33269	20854	76245
1978	2698	19158	33450	20313	75619
1979	5575	17505	39830	8508	71418
1980	6779	17262	36400	7668	68109
1981	7538	20761	35593	8035	71927
1982	7895	22913	44401	8951	84160
1983	11762	27750	45593	10607	95712
1984	20385	35390	50373	16944	123092
1985	33517	51376	58060	14082	157035
1986	39112	61721	59849	11820	172502
1987	43877	69975	61185	14881	189918
1988	43714	73149	63911	43903	224677
1989	48707	75304	19194	65474	208679
1990	46429	74408	17033	82762	220632

⟨Source : Korea Tourism Promotion Association, Foreigners to Korea (Monthly Report)⟩

〈Table A-3〉 Final Consumption Expenditure per Capita

Year	Current Expense ($ billon)	Real Expense			C.P.l. (%)
		Amount ($billon)	per capita	Rate (%)	
1964	409.3	1421.2	7406	4.65	28.8
1965	440.7	1504.1	7741	4.52	29.3
1966	477.3	1580.5	8040	3.86	30.2
1967	503.5	1624.2	8173	1.65	31.0
1968	552.5	1710.5	8522	4.27	32.3
1969	597.9	1753.4	8651	1.51	34.1
1970	640.0	1772.9	8646	-0.06	36.1
1971	691.5	1839.1	8856	2.43	37.6
1972	757.6	1947.6	9278	4.77	38.9
1973	837.2	2027.1	9565	3.09	41.3
1974	916.5	2001.1	9357	-2.17	45.8
1975	1012.8	2025.6	9379	4.08	50.0
1976	1129.4	2135.0	9791	4.39	52.9
1977	1257.2	2233.0	10138	3.54	56.2
1978	1403.5	2316.0	10404	2.62	60.6
1979	1566.7	2321.0	10312	-0.88	67.5
1980	1732.6	2264.8	9943	-3.52	76.5
1981	1915.1	2266.4	9847	-0.97	84.5
1982	2050.7	2286.2	9832	-0.15	89.7
1983	2234.5	2413.1	10277	4.53	92.6
1984	2426.4	2511.8	10598	3.12	96.6
1985	2629.0	2629.0	10987	3.67	100.0
1986	2807.5	2755.2	11403	3.79	101.9
1987	3012.1	2849.7	11682	2.45	105.7
1988	3235.1	2943.7	11950	2.29	109.9
1989	3471.1	3013.1	12080	1.09	115.2

〈Source : IMF, International Financial Statistics Yearbook(1990)〉

⟨Table A-4⟩ GDP of U.S.A.

Year	Current GDP ($billon)	Real GDP			GNP Deflator
		Amount ($billon)	(Real GDP) per capita	Rate (%)	
1964	644.4	2169.7	11307	3.77	29.7
1965	699.3	2300.3	11839	4.70	30.4
1966	766.4	2433.0	12378	4.55	31.5
1967	810.5	2501.5	12589	1.70	32.4
1968	885.9	2605.6	12982	3.12	34.0
1969	957.1	2666.0	13154	1.32	35.9
1970	1008.3	2660.4	12974	-1.37	37.9
1971	1093.4	2733.5	13163	1.46	40.0
1972	1201.6	2867.8	13663	3.80	41.9
1973	1343.1	3011.4	14211	4.01	44.6
1974	1353.4	2990.5	13984	-1.60	48.6
1975	1580.9	2956.0	13687	-2.12	53.5
1976	1761.7	3101.6	14225	3.93	56.8
1977	1965.1	3247.7	14746	3.66	60.6
1978	2219.2	3408.9	15315	3.86	65.1
1979	2464.4	3480.8	15466	0.99	70.8
1980	2684.4	3472.7	15247	-1.41	77.3
1981	3005.5	3548.4	15418	0.10	84.7
1982	3114.8	3457.0	14868	-3.57	90.1
1983	3355.9	3585.4	15270	2.70	93.6
1984	3724.8	3828.2	16153	5.78	97.3
1985	3974.2	3974.2	16609	2.82	100.0
1986	4205.4	4094.8	16947	2.04	102.7
1987	4497.2	4238.6	17376	2.53	106.1
1988	4847.3	4434.9	18004	3.61	109.3
1989	5198.4	4568.0	18315	1.73	113.8

⟨Source : IMF, ibid.⟩

⟨Table A-5⟩ Air Fare (between L.A. and Seoul)

(unit:$)

Year	Normal One Way Economy Fare (Nominal)	Real Fare	
		Amount	Rate(%)
1970	464	1285	
1971	464	1234	-3.97
1972	464	1192	-3.40
1973	464	1123	-5.79
1974	554	1209	7.66
1975	598	1196	-1.08
1976	581	1098	-8.19
1977	581	1033	-5.92
1978	581	958	-7.26
1979	581	860	-10.23
1980	710	928	7.91
1981	756	894	-3.66
1982	794	885	-1.01
1983	842	909	2.71
1984	842	871	-4.18
1985	842	842	-3.33
1986	842	826	-1.90
1987	884	875	5.93
1988	884	842	-3.77
1989	884	804	-4.51
1990	884	767	-4.60

⟨Source : IATA, Tariff ⟩

⟨Table A-6⟩ Transactions between Korea and U.S.A.

(unit:$ million)

Year	Import from Korea	Export to Korea	Tatal Amount	
			Amount	Rate(%)
1964	159	711	870	22.39
1965	274	622	896	2.99
1966	412	603	1015	13.28
1967	587	823	1410	38.92
1968	997	978	1975	40.07
1969	1299	1641	2940	48.86
1970	1519	1720	3239	10.17
1971	1941	1932	3873	19.57
1972	2590	1783	4373	12.91
1973	2934	2848	5782	32.22
1974	2891	3155	6046	4.57
1975	2733	3119	5852	-3.21
1976	4297	3150	7447	27.26
1977	4973	3794	8767	17.73
1978	5994	4410	10404	18.67
1979	5466	5863	11329	8.89
1980	4547	5488	10035	-11.42
1981	5206	6217	11423	13.83
1982	5821	6052	11873	3.94
1983	8063	6312	14375	21.07
1984	10213	6820	17033	18.49
1985	10754	6489	17243	1.23
1986	14368	6480	20848	20.91
1987	17674	8528	26202	25.68
1988	19709	11608	31317	19.52
1989	17285	14105	31390	0.23

⟨Source : Korea Trade Association, Foreign Trade (Monthly Report)
IMF, International Finance Statistics⟩

<Tabel A-7> Foreign Exchange Rate

Year	Won/$	$/Won	Rate(%) of won/$
1968	281.50	0.0036	2.59
1969	304.45	0.0033	8.15
1970	316.65	0.0032	4.01
1971	373.20	0.0027	17.86
1972	398.90	0.0025	6.89
1973	397.50	0.0025	-0.35
1974	484.00	0.0021	21.41
1975	484.00	0.0021	--
1976	484.00	0.0021	--
1977	484.00	0.0021	--
1978	484.00	0.0021	--
1979	484.00	0.0021	--
1980	659.00	0.0015	157.57
1981	700.50	0.0014	163.86
1982	748.80	0.0013	6.90
1983	795.50	0.0013	6.23
1984	827.40	0.0012	4.01
1985	890.20	0.0011	7.59
1986	861.40	0.0012	-3.24
1987	792.30	0.0013	-8.02
1988	684.10	0.0015	-13.66
1989	679.60	0.0015	-0.66
1990	716.40	0.0014	5.42

< Source : Bank of Korea, Monthly Statistics >