Forecasting Issues Related to San Diego Airport

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San Diego's Lindberg Airport

- A brief history
  - Busiest single runway airport in the country
  - Small in size (661 acres) relative to airports in similar cities with similar populations
- Over 30 studies and almost 50 years of formal discussion about what to do about Lindberg Field

San Diego Airport Authority

- Created by California Legislature in 2001
- Given charge to examine airport options
- Has spent 8+ million dollars on new studies
- Held extensive public hearings
- Is suppose to propose a ballot measure for November election

Current Options

- Do nothing
- Expand terminal facilities at Lindberg
- Alter runway capacity at Lindberg
  - Lengthen existing runway
  - Add runway
- Build new airport to replace Lindberg
- Take over Miramar MAS or North Island NAS
- Build/expand an auxiliary airport

Current View of San Diego Airport Authority

- Lindberg Field capacity may be exceeded by 2015 and for sure by 2030
- This will result in a loss of regional gross domestic product of $94 billion dollars
- Believes this implies a new airport with two 12,000 foot runways is needed
- Basis for this is two consultant reports by HR&A and SH&E

The Difficulty

- SD Airport Authority narrowed non-military new sites down to two locations:
  - Campo ($10.2 billion)
  - Imperial County ($13.2 billion)
- Military does not want to give up Miramar or North Island and does not want to allow joint use

A Second Look At Lindberg Runway Situation

- Reasons for wanting to replace/expand:
  - Ground operations/runway coordination
  - Emergency situations
  - Periodic reductions in capacity (weather)
  - Insufficient capacity for desired take-off and landing “slots”

Forecasting the Future

- Air Cargo
- Air Passengers

Air Cargo

- Accounts for roughly 80% of HR&A’s $94 billion dollar in gross regional domestic product
- HR&A’s Input-Output modeling approach effectively assumes that economic activity that generates air cargo moves out of San Diego

Problems with How Input-Output Approach Is Used in Analysis

- Ignores substitution
  - Other airports (Ontario, Yuma, LAX, TJ)
  - Other forms of transportation (Truck, Rail)
- Effectively assumes average and marginal effects are the same
- Incorrectly assumes that a gross output measure (rather than a net/surplus measure) is of policy interest

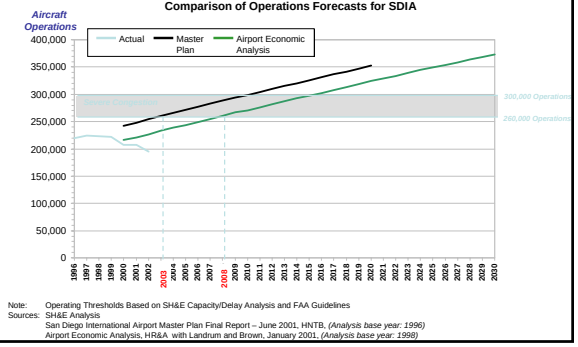
Air Passengers Three Distinct Issues

- Forecasting passenger demand is distinct from forecasting demand by airlines for takeoff/landing slots
  - More passengers in the extreme case decrease the demand for runway slots
- Forecasting takeoff/landing slot demand
- Response to constraints on available slots

Demand for Slots

- Forecasted number of passengers (PAX)
  - Per capita demand
  - Projected increase in population
- Desired O-D schedule
  - Current non-stops
  - Potential non-stops
  - Mix of plane types
  - International flights

Trend in Slot Utilization At Odds with SH&E Forecast



Note: Operating Thresholds Based on SH&E Capacity/Delay Analysis and FAA Guidelines
Sources: SH&E Analysis
San Diego International Airport Master Plan Final Report – June 2001, HNTB, *(Analysis base year: 1996)*
Airport Economic Analysis, HR&A with Landrum and Brown, January 2001, *(Analysis base year: 1998)*

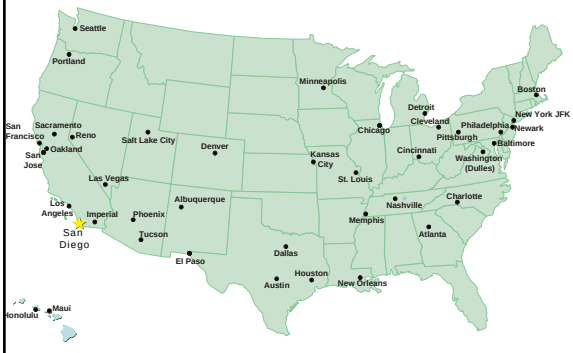
Flight Operations by Category January-June 2000-2005

Year	Total	Airline Carriers	Airline Comm.	Civil	Military
1999	109,920	71,995	29,535	7,794	633
2000	100,897	76,404	16,310	7,863	320
2001	106,700	75,270	24,083	6,849	518
2002	99,251	70,650	20,418	7,592	636
2003	99,600	69,151	22,874	6,963	612
2004	103,366	71,594	23,561	7,140	1,071
2005	107,482	74,300	26,278	6,645	259

Relationship of Operations to San Diego Airline Passengers

- Statistically quite a weak relationship
- Forecast range for number of PAX may be less important than:
  - Examination of current/forecast OD preferences
  - Examination of current/potential non-stop routes
- Forecast of likely mix of airplane types in response to above

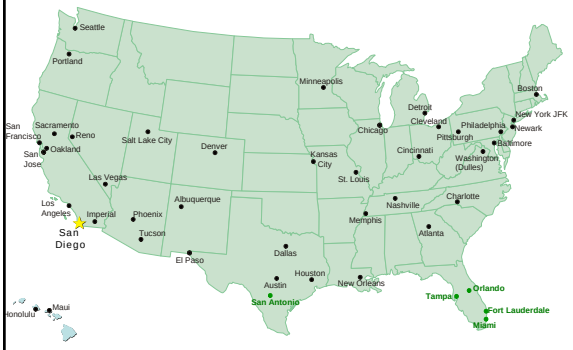
Current SAN Domestic Non-Stop Routes



Possible New Non-Stops With Regular Jet Service

- Orlando (only top 20 destination not served)
- Other Florida locations in top 50
  - Fort Lauderdale
  - Tampa
  - Miami
- San Antonio
- Washington (DCA)/La Guardia if allowed

Most Likely New Non-Stop Routes In Green



Domestic Airport Pairs with Next Highest Traffic

International Destinations

- Current and likely to continue
  - Los Cabos (SJD)
  - Vancouver
- Marginal
  - Toronto (Air Canada gateway to Europe)
  - London (LHR)
  - Paris (CDG)
  - Some Mexican cities

Implications for Runway Specifications

- Canadian and Mexican locations can be supported by narrow-bodied aircraft
- European locations are marginal with a Boeing 777 and cannot support a 747-400
- Chance of needing two long runways to support simultaneous launch of two long haul wide-bodied aircraft effectively zero
- New perspective routes likely to be served by regional jets or narrow-bodied aircraft

Mix of Planes

- Passengers want
  - Non-stop flights
  - Distribution of “ideal” departure times
  - Regular jets over regional jets over prop jets
  - Low cost
- Airlines maximize profits subject to:
  - Actions of other airlines
  - Cost per PAX declines rapidly with aircraft size
  - Higher cost if connection via hub

Scaling Up Plane Capacity

Plane Type	Examples	Seat Range
Turbo prop	EM2	30-40
Regional jet (small)	CRJ-200	40-50
Regional jet (large)	EMB-190	50-100
Narrow-bodied jet I	B373-3x/A318	100-150
Narrow-bodied jet II	B757/A321	150-250
Wide-bodied jet I	B777/A340	250-400
Wide-bodied jet II	B747-4x/A380	400+

SH&E Passenger Forecast Model

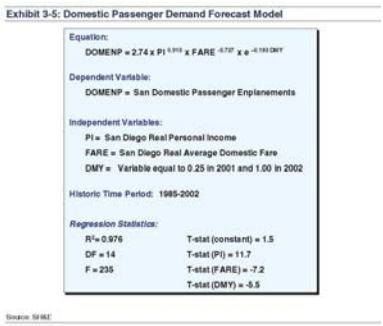


Exhibit 3-5: Domestic Passenger Demand Forecast Model

Equation:

DOMENP = 2.74 x PI $^{0.913}$ x FARE $^{-0.737}$ x e $^{-0.193\ DMY}$

Dependent Variable:

DOMENP = San Domestic Passenger Enplanements

Independent Variables:

PI = San Diego Real Personal Income

FARE = San Diego Real Average Domestic Fare

DMY = Variable equal to 0.25 in 2001 and 1.00 in 2002

Historic Time Period: 1985-2002

Regression Statistics:

R^2 = 0.976 — T-stat (constant) = 1.5

DF = 14 — T-stat (PI) = 11.7

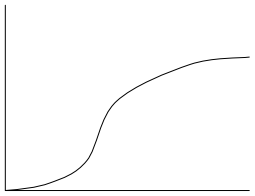
F = 235 — T-stat (FARE) = -7.2

T-stat (DMY) = -5.5

Problems with SH&E Model

- Very limited data (22 annual observations)
- Results dominated by high growth of 1980's
- Fails to separate out factors determining per capita propensity to fly and population growth likely to mask true drivers
- Other basic econometric errors: (1) SH&E effectively regress two trending variables on each other [results are thus potential spurious], (2) average fare is an endogenous regressor, (3) no testing was done of their model's out-of-sample forecasting ability

Trips per capita



Per Capita Income

Description of Data

- Quarterly number of passengers at each U.S. airport including San Diego from BTS
- Quarterly population estimates for each MSA
- Lower 48 crude petroleum price per barrel from US Energy Administration
- Quarterly BLS Unemployment Rate for each MSA
- Futures Price for crude (Brent) petroleum from Commodity Research Bureau
- Quarterly Coincident Economic activity indicator at state level for US from Philadelphia Fed

Forecasting Model

- The dependent variable is defined as the logit transformation of number of flights per capita,

$$y_t = \ln\left(\frac{pax_t / pop_t}{1 - pax_t / pop_t}\right)$$

- The model is estimated in the sample using quarterly data between 1990:Q1 and 2004:Q4:

$$y_t = \beta_1 trend_t + \beta_2 unemp_t + \beta_3 ci_t + \beta_4 ci_t^2 + \beta_5 oilprice_t + \beta_6 \Delta(oilfutures)_t + \beta_7 popgr_t + \beta_8 sept11_t + \sum_{i=1}^{8} \phi_i y_{t-i} + c$$

Pooled Estimation Results for San Diego

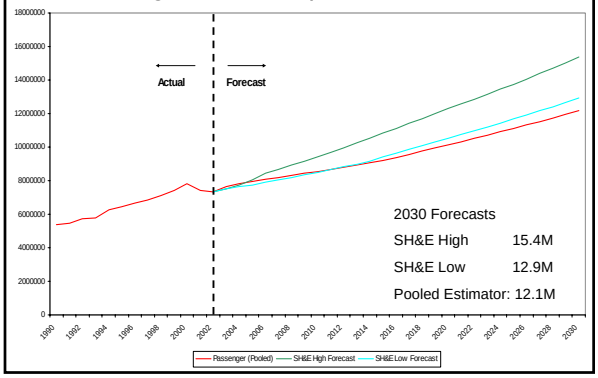
Variable	Coefficient	Std. Error	t-Statistic	Prob.
TREND?	0.001282	0.001157	1.107864	0.2680
UNEMP?	-0.017175	0.003061	-5.611176	0.0000
CI?	0.009059	0.005049	1.794342	0.0728
CI?^2	-3.70E-05	1.81E-05	-2.046395	0.0407
OILPRICE?	0.000599	0.000187	3.202672	0.0014
D(CBNB3?)	-0.000742	0.000635	-1.168990	0.2424
POPGR?	-0.009513	0.004654	-1.829078	0.0674
SEPT11DUMMY?	-0.128114	0.006624	-19.34165	0.0000
AR(1)	0.702774	0.010748	65.38848	0.0000
AR(2)	0.045216	0.013448	3.362219	0.0008
AR(3)	-0.065481	0.013419	-4.879737	0.0000
AR(4)	0.657411	0.011925	46.74251	0.0000
AR(5)	-0.583013	0.011542	-50.51226	0.0000
AR(6)	-0.026827	0.013463	-2.141228	0.0323
AR(7)	-0.009387	0.013451	-0.697885	0.4853
AR(8)	0.251291	0.011242	22.35360	0.0000
Fixed Effects (Cross)				
_SAN--C	-4.387665			

R-squared	0.989910	Mean dependent var	-4.604098
Adjusted R-squared	0.989672	S.D. dependent var	1.227134
S.E. of regression	0.124708	Sum squared resid	129.9524
F-statistic	4161.468	Durbin-Watson stat	1.849357
Prob(F-statistic)	0.000000		

Forecasting Methodology

- Forecasting Explanatory Variables
  - Quarterly population estimates are formed by linear interpolation/extrapolation of long-term population forecasts from SANDAG
  - U.S Energy Administration quarterly oil price forecasts
  - Unemployment rate set to 5% long-term average
  - The change in oil futures price is set to zero
  - The coincident indicator forecasted using AR(2) model
- The pooled model is estimated for all U.S. airports with fixed effects for the187 largest airports plus "other airports"
- Long-term (2004:Q1-2030:Q4) per capita forecasts used estimated model parameters with assumptions about exogenous variables to get per capita forecasts
- Per capita estimates multiplied San Diego pop. forecast.
- Forecast error over short/moderate horizon (5 quarters) less than half of standard FAA approach

San Diego Annual Enplanement Forecast



Airline Reactions to Slot Constraints

- Increase price if possible
  - Empirical evidence consistent with 2%-10% higher prices
- Use larger planes
  - More PAX with same O-D preferences allows larger planes to be used
  - Reduce frequency of service allows route to be served by larger planes
  - Eliminating marginal non-stops in favor of hub service allows larger planes on hub routes

Potential Problems With Slot Constraints

- Allowing too much congestion
- Letting airlines gain market power through possession of slots
- Associating slots with particular routes
- Failing to recognize for planning purposes that the "marginal" use of a slot is likely to be for a regional jet
- Failing to "effectively" price the scarce slot resource so airlines respond appropriately

Economic Losses From Slot Constraints

- No loss if shift is simply to larger aircraft
- At the margin, economic loss to a region from a "lost" PAX must be essentially zero
- As long as number of lost PAX is not a large fraction of total unconstrained demand:
  - Losses must be much smaller than those based on "average" cost input/output models such as those used by HR&A:
    - Passengers who had lowest values for trip don't fly
    - Some of those trips still made via car/bus/train
    - Consumers/business utilize close substitutes

Air Passenger Summary

- Flight operations at SAN flat for a decade
- Relationship between PAX numbers and flight operations is not the almost linear one suggested by SH&E's analysis
- Few changes likely in current SAN non-stop pattern of flights
- Increases in number of PAX likely supported primarily by larger aircraft not more flights

Summary Continued

- SH&E's forecast procedure not appropriate
  - At best, black box curve fitting with no insight into the demand generation process
    - Need to separate out changes in flights per capita from changes in population
  - SH&E's high forecast is implausibly high
  - Alternative pooled model using data from airports across the United Stated suggest SAN PAX estimate below SH&E low estimate

Summary Continued

- Empirical evidence on slot constrained airports suggests:
  - Small to moderate price increases
  - Shift (when allowed) to larger aircraft
  - Small loss in PAX. Passengers lost are those with the lowest value for that trip via air