International Civil Aviation Organization

A39-WP/64
EC/8
5/7/16

WORKING PAPER

ASSEMBLY — 39TH SESSION

ECONOMIC COMMISSION

Agenda Item 41: Aviation Data— Monitoring and Analysis

REPORT ON THE DEVELOPMENT OF A SINGLE SET OF HARMONIZED LONG-TERM FORECASTS

(Presented by the Council of ICAO)

EXECUTIVE SUMMARY

This working paper reports on activities in the area of aviation forecasts in accordance with Assembly Resolution A38-14, which requested to develop one single set of long-term traffic forecasts. The multi-disciplinary group, including States, international organizations, and experts who are also nominated to participate in the Committee of Aviation Environmental Protection (CAEP) working groups, developed the new forecasting models and methodologies. The estimated results indicate that global passenger and freight traffic will grow at 4.6 per cent and 4.4 per cent respectively, on an annual basis to 2032. This paper also presents ICAO's plan for future work related to forecasting (a part of the aviation data and analysis work programme). It will focus on the further refinement of econometric methodologies to update the existing forecasts, and the development of detailed customized forecasts to meet the varied needs of States and other stakeholders.

Action: The Assembly is invited to:
a) review the work accomplished by ICAO in paragraphs 2 and 3;
b) endorse the Organization's work plan as presented in paragraph 4; and
c) consider the information contained in this paper for the update of Assembly Resolution A38-14, Consolidated Statement of continuing ICAO's policies in the air transport field.

Strategic Objectives:	This working papers relates to Strategic Objective D — *Economic Development of Air Transport*.
Financial implications:	The activities referred to in this paper will be undertaken subject to the resources available in the 2017–2019 Regular Programme Budget and/or from extra budgetary contributions.
References:	Doc 9956, *Global and Regional 20-Year Forecasts for: Pilots, Maintenance Personnel, Air Traffic Controllers, 2011* Doc 10027, *Report of the Economic Commission of the 38th Session of the Assembly* Doc 10022, *Assembly Resolutions in Force* (as of 4 October 2013) Cir 333, *Global Air Transport Outlook to 2030 (GATO)* A39-WP/8, Consolidated statement of continuing ICAO policies in the air transport field

1. BACKGROUND

1.1 With a view to responding to the needs of States, regional air navigation planning groups and environmental planning bodies, several sets of long-term traffic forecasts were developed under the auspices of ICAO over the past decade. In considering this development and the resulting complexities, Resolution A38-14 requested the Council to "develop one single set of long-term traffic forecasts, from which customized or more detailed forecasts can be produced for various purposes, such as safety, air navigation systems planning and environmental analysis".

1.2 The Multi-disciplinary Working Group on Long-term Traffic Forecasts (MDWG-LTF) under the Aviation Data and Analysis Panel (ADAP) was tasked to develop a single set of long-term traffic forecasts. The MDWG-LTF comprised of ten Member States and three international organizations. The membership of MDWG-LTF also included five members who were also nominated to working groups of the Committee on Aviation Environmental Protection (CAEP). The work of the group has resulted in the replacement of ICAO's decade-old simple forecasting techniques with more rigorous econometric models.

2. DATA AND MODEL SPECIFICATION

2.1 A time-series data set of Revenue Passenger Kilometres (RPK) and Freight Tonne Kilometres (FTK) was created for both international and domestic operations at city pair and carrier levels from 1995 to 2012 by compiling:

a) *actual* traffic data reported by States to ICAO (through the Air Transport Reporting Forms A, B and C) and published directly by States, the coverage of which was over 90 per cent of air passenger traffic and 95 per cent of freight traffic; and

b) *estimated* traffic data based on the airline schedules published in the Official Airline Guide (OAG), which was used to fill the gaps.

2.2 This initial data set was subsequently reconciled with *operations* data in the Common Operations Database (COD) maintained by the CAEP in order to establish common baseline traffic volumes for the year 2012.

2.3 While the previous passenger traffic forecasts made in 2013 by the CAEP consisted of 32 route groups, the MDWG-LTF decided to segment passenger forecasts into a total of 50 route groups (40 international and 10 domestic, Appendix refers). In order to obtain the flexibility of having different elasticity estimates based on income level and market maturity, these 50 route groups were assigned to six different tiers based on the World Bank definitions of low, lower-middle, upper-middle and high-income economies (http://data.worldbank.org/about/country-and-lending-groups)[1]. Concerning freight forecasts, since nearly 80 per cent of the traffic moves in the East-West trade lane, it was decided to use six regions instead of the 50 route groups.

[1] The 6 tiers are: T1 = both origin and destination are low-income economies; T2 = origin is low-income economies and destination is either lower-middle or upper-middle income economies or vice versa; T3 = origin is high-income economies and destination is low income economies or vice versa; T4 = origin is high-income economies and destination is either lower-middle or upper-middle income economies or vice versa; T5 = both origin and destination are either lower-middle or upper-middle income economies; and T6 = both origin and destination are high-income economies.

2.4 The specification of the appropriate dynamic demand equations followed economic theories and a "general to specific" approach that starts with a model which is over parameterised[2] and then simplifies to a more specific form on the basis of statistical tests and the overall explanatory power of the model. After a series of diagnostic tests, the equation selected to predict annual change in passenger traffic for each route group is a function of real GDP per capita and cost of travel:

$$\Delta log\widehat{RPK}pc_{rt} = \sum_{i=1,j=1}^{6} \beta_i \left(T_j * \Delta logGDPpc_{rt}\right) + \beta_{Oil}\Delta log \;\; Cost\ of\ Travel_{rt} + dummies$$

i: tier coefficient index, j: tier index, t: year, r: route group, pc: per capita, Δ: difference between t and t-1

2.5 As there is no coherent methodology to obtain specific airfare costs, oil prices were used as a proxy for cost of air travel, consistent with recent literature on this topic. In addition, dummy variables are added to the model to take into account the effect of "special" events such as those of 11 September 2001 and the Severe Acute Respiratory Syndrome (SARS) outbreak.

2.6 A panel data analysis using a first difference estimator (i.e. based on difference between year t and year t-1) was used to estimate the passenger traffic equation. This approach best fits the dataset and information available for estimation while allowing for controlling of both time series and cross-sectional aspects of the data.

2.7 Unlike the passenger demand model, the equation of the freight demand for most of the regions includes real GDP per capita as a sole explanatory variable because the estimated coefficients of oil prices were not statistically significant.

$$\widehat{logFTK_t} = \alpha + \beta \;\; logGDP_t \qquad \text{t: year}$$

2.8 Individual ordinary least squares (OLS) regression was used for each region as it performed better than other approaches.

3. RESULTS OF ESTIMATION

3.1 The predicted changes in the RPKs and predicted annual FTKs are used to calculate Compound Annual Growth Rates (CAGR) of passenger and freight traffic for a ten (2012-2022), twenty (2012-2032) and thirty year (2012-2042) period. The estimated results are summarized in Appendix to this paper. More details are presented in the reference material to the Assembly.

3.2 The estimated results indicate that global passenger traffic will grow at 4.6 per cent annually to 2032. Fourteen route groups outpace the global growth, including all route groups involving Central Southwest Asia. The fastest growing route group is Domestic Central Southwest Asia, which is estimated to grow at around 10 per cent annually. The growth rates of route groups in and between Africa, Central America/Caribbean and Middle East are close to the global growth rate. Route groups in and between mature markets including Europe, North America, and North Asia have a lower estimate of growth rate.

[2] Explanatory variables considered and tested include gross domestic product (GDP), income, population, travel cost, international trade volumes and employment.

3.3 Global freight traffic is expected to grow at 4.4 per cent annually over the same time period as passenger forecasts. The Middle East has the highest forecast of annual growth outpacing global estimate by about 2.8 percentage points. The growth rate of Asia/Pacific is close to the global estimate, at 4.7 per cent. Europe, Latin America/Caribbean, and North America will grow at a slightly slower pace than Asia/Pacific while Africa has the lowest annual growth rate of 2.1 per cent.

4. FUTURE WORK

4.1 A single set of long-term traffic forecasts presented in this paper forms the basis for effective planning activities in States and ICAO. Such forecasts are critical to effectively implement ICAO's No Country Left Behind (NCLB) initiative, estimate future trends of noise, emissions and particulate matter, assess the operational and cost-effectiveness of air navigation systems including the Aviation System Block Upgrades (ASBU), and assess licensed personnel and training requirements, as well as for the infrastructure planning and capacity building for improved safety of operations.

4.2 The focus and priority of future work in the area of aviation forecasts (a part of the aviation data and analysis work programme) will, therefore, be placed on the further refinement of econometric methodologies to update the existing forecasts, and the development of detailed customized forecasts to meet the varied needs of States and other stakeholders. In conducting this work, the Organization will, inter alia:

a) develop an electronic interface by October 2017, allowing States and other users to generate customized forecasts at different levels of granularity (for example, by route, by country-pair, by State of departure, by airport);

b) customize forecast results/data required for the CAEP to develop its fleet forecasts, trends and assessment activities;

c) customize forecast results/data required for the MDWG-ASBU and Traffic Forecasting Groups for their air navigation service planning and assessment activities at a global and regional level; and

d) updated global and regional twenty year forecasts for pilots, maintenance personnel and air traffic controllers (DOC 9956) in April 2018 to meet the needs of the ICAO Next Generation Aviation Professional (NGAP) programme.

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APPENDIX

Passenger Traffic Forecasts (RPKs)

Route Group	10 Year (2012-2022)	20 Year (2012-2032)	30 Year (2012-2042)
Africa Domestic	4.6%	4.5%	4.3%
Africa & Middle East - Central America/Caribbean	4.5%	4.4%	4.3%
Africa & Middle East - South America	3.1%	3.8%	4.2%
Africa - Asia/Pacific	6.6%	6.1%	5.8%
Africa - Middle East	4.5%	4.9%	4.7%
Africa - North America	3.3%	3.1%	3.1%
Central America/Caribbean Domestic	4.0%	4.2%	4.2%
Central America/Caribbean - Europe	3.1%	3.2%	2.9%
Central America/Caribbean - North America	4.2%	4.0%	3.7%
Central America/Caribbean - South America	2.8%	3.8%	4.0%
Central/South West Asia - North Asia	9.1%	8.4%	7.7%
Central/South West Asia - Pacific South East Asia	8.9%	7.9%	7.4%
Central/South West Asia Domestic	10.3%	8.8%	7.6%
Central/South West Asia - Europe	5.5%	5.2%	4.7%
Central/South West Asia - Middle East	8.2%	8.6%	8.2%
Central/South West Asia - North America	7.3%	6.3%	5.5%
Europe Domestic	2.5%	2.5%	2.5%
Europe - Middle East	3.4%	3.1%	2.9%
Europe - North Africa	3.2%	3.3%	3.3%
Europe - North America	2.9%	2.8%	2.7%
Europe - North Asia	2.3%	2.3%	2.2%
Europe - Pacific South East Asia	3.6%	3.8%	3.6%
Europe - South America	2.8%	3.0%	2.9%
Europe - Sub Saharan Africa	2.0%	2.1%	2.0%
Intra Africa	4.5%	4.5%	4.3%
Intra Central America/Caribbean	4.1%	4.2%	4.2%
Intra Central/South West Asia	10.0%	8.7%	7.7%
Intra Europe	2.5%	2.5%	2.5%
Intra Middle East	4.7%	4.7%	4.4%
Intra North America	3.3%	3.0%	2.9%
Intra North Asia	1.7%	1.6%	1.4%
Intra Pacific South East Asia	5.4%	5.3%	5.1%
Intra South America	2.2%	3.2%	3.5%
Latin America/Caribbean - Central/South West Asia	8.0%	7.7%	6.7%

Route Group	10 Year (2012-2022)	20 Year (2012-2032)	30 Year (2012-2042)
Latin America/Caribbean - North Asia & Pacific South East Asia	2.6%	2.9%	2.7%
Middle East Domestic	4.7%	4.7%	4.4%
Middle East - North America	4.4%	3.6%	3.4%
Middle East - North Asia & Pacific South East Asia	4.1%	3.7%	3.5%
North America Domestic	3.3%	3.0%	2.9%
North America - North Asia	2.8%	2.6%	2.5%
North America - Pacific South East Asia	4.4%	4.3%	4.1%
North America - South America	3.8%	3.7%	3.5%
North Asia Domestic	1.7%	1.6%	1.4%
North Asia - Pacific South East Asia	3.7%	3.8%	3.6%
Pacific South East Asia Domestic	5.4%	5.3%	5.1%
South America Domestic	2.2%	3.2%	3.5%
World Total	**4.7%**	**4.6%**	**4.5%**

Freight Traffic Forecasts (FTKs)

Region	10 Year (2012-2022)	20 Year (2012-2032)	30 Year (2012-2042)
Middle East	6.7%	7.2%	7.0%
Asia and Pacific	5.2%	4.7%	4.3%
North America	3.7%	3.5%	3.4%
Latin America/Caribbean	3.4%	3.1%	3.0%
Europe	2.9%	2.6%	2.4%
Africa	1.6%	2.1%	2.2%
World Total	**4.5%**	**4.4%**	**4.2%**

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