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Air passenger departures forecast models – A technical note

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1. Introduction

Sine 1999, the Ministry of Business, Innovation and Employment has produced tourism forecasts annually with a seven-year projection period[1]. Auckland Airport (2014) has also made tourism forecasts up to 2025. However, these forecasts are only for international arrivals by foreigners. The Aviation Security Service (2013, personal communications) has developed a short-term forecast model for air passengers undergoing security screening. No forecasts have been made for international departures by New Zealand residents or for total domestic air passenger departures. The air travel demand forecast models in this work consists of two parts: one is for international passenger departures by New Zealand residents[2], and the other for total domestic air travel departures by both New Zealand residents and foreigners (except those without paying airfares, e.g. infants and crew).

A forecast model could be developed through the conventional ordinary least square (OLS) approach. This method is easy to use and can generally produce reasonably good empirical results (Witt and Witt, 1995). It has been used in many tourism and transport demand forecasting studies. For example, BITRE (2012) has used this approach to produce Australian official forecasts of air passenger movements. However, the conventional OLS approach could be associated with some statistical issues, typically spurious regressions due to common trends (non-stationary variables). Advanced econometric modelling techniques have been developed for tourism demand forecasting to address the spurious regressions issue (Song and Li, 2008; Li et al., 2005; Song and Witt, 2000).

There are several ways to deal with the issue. The unit root(s) of a non-stationary variable can be removed by differencing. The models based on differenced variables maybe termed as ‘growth rate’ models. On the other hand, the error correction modeling (ECM) approach allows the use of non-stationary variables (Song and Witt, 2000). We have used both the Engle-Granger two-stage ECM approach and the Wickens-Breusch one-stage ECM approach. The Engle-Granger approach could be biased in small samples, while the Wickens-Breusch approach does not suffer from the problem (Song and Witt, 2000). Due to an insufficient number of observations, we did not apply the ECM methods to the domestic air passenger departure data.

2. Explanatory variables and data sources

The following economic factors are used as explanatory variables (see Figures 2.1 - 2.2 for the trends of some key variables):

- New Zealand’s real gross domestic product per capita (GDPrPC), which measures general income, or more broadly speaking, overall economic performance

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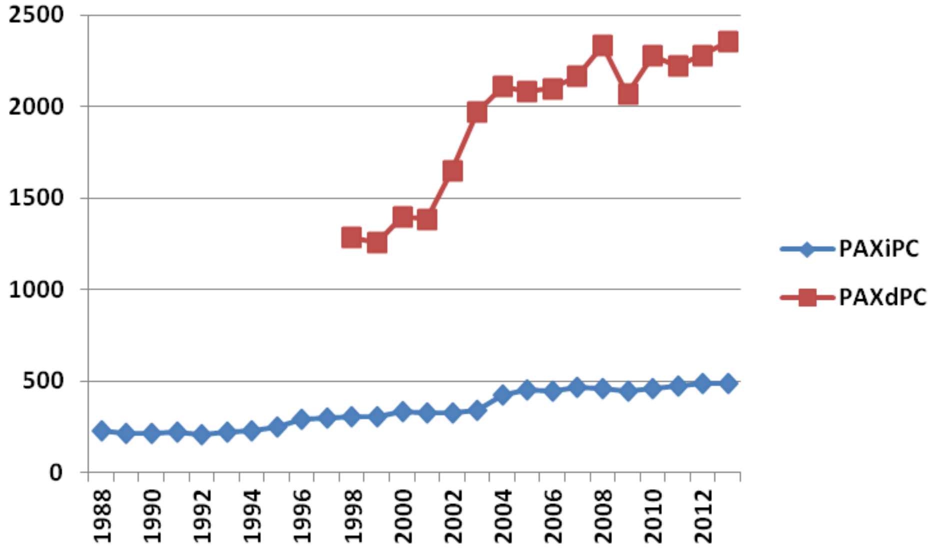
[1] Information related to the programme can be found at: http://www.med.govt.nz/sectors-industries/tourism/tourism-research-data/forecasts

[2] International departures by NZ residents include those by both air and sea. However, the share of sea passengers has been mostly below 1%.

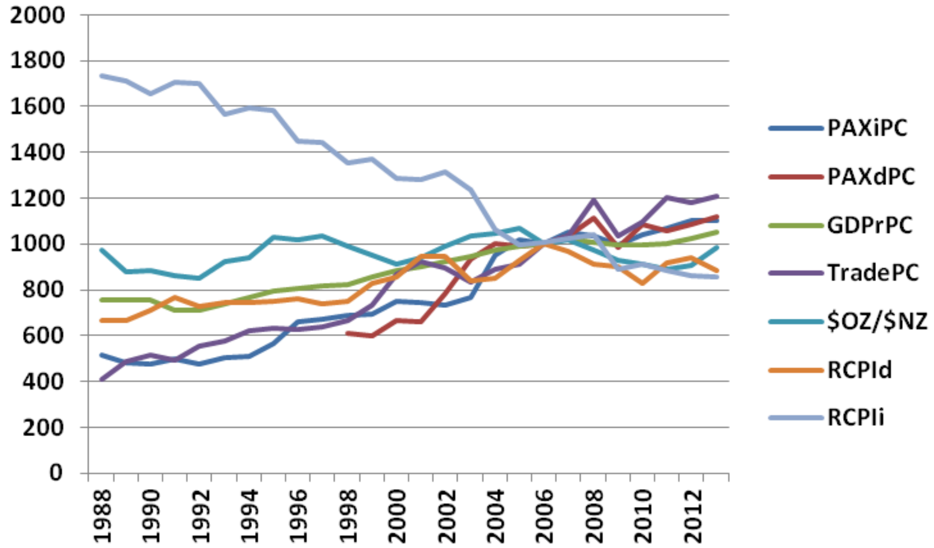
- New Zealand's total international trade value (i.e. sum of imports and exports). This is closely related to business connections (Turner and Witt, 2001)
- Exchange rates (per NZ dollar)
- Consumer price index for international air travel (CPIi), and for domestic air travel (CPId); they are adjusted through dividing them by all group CPI, which converts them into indices (RCPIi and RCPId) based on airfares in real term
- Unemployment rate in New Zealand
- Brent crude oil price (Brent, in US dollars per barrel).

Figure 2.1: International and domestic departures per capita



Note: PAXiPC = International departures per capita (per 1000 NZ population)
PAXdPC = Domestic air passenger departures per capita (per 1000 NZ population)

Figure 2.2: Trends of major economic variables



Note: Economic variables are indexed to 2006 = 1000, except for RCPId and RCPIi

The following major events are taken into consideration in the international departure module using dummy variables:

- The 2008/09 Global Financial Crisis (GFC)
- The introduction of a low-cost operation model by Air New Zealand for short-haul international flights (late 2003, AirNZ_Intl)
- September 11, 2001 (SEP11)
- The SARS epidemic (November 2002 – July 2003)

For the domestic air departure module, the following big events are considered:

- The 2008/09 Global Financial Crisis (GFC)
- The introduction of a low-cost operation model by Air New Zealand (mid-2002, AirNZ)
- Jetstar entered the New Zealand market in June 2009 (Jetstar)

Most economic data were obtained from Statistics New Zealand, except exchange rates from the Reserve Bank of New Zealand and Brent crude oil price data from the US Energy Information Agency. Annual data from 1988 to 2010 are used to develop the international departure module (from Statistics New Zealand), with those from 1998 to 2010 for the domestic module (from the Civil Aviation Authority of New Zealand). The 2011 and 2013 air passenger departure numbers are used to evaluate forecasting performance. None of the variables have missing or “strange” values.

Forecasts on economic variables were performed by the Treasury. However, Treasury does not have forecasts on CPI for air travel, which we have estimated by considering their historic trends.

Economic factors on the supply side such as available seats and routes are not explicitly included. Nevertheless, CPId and CPIi are closely related to supply capacity.

Statistical analyses are carried out using the EViews 7 software package.

3. Modelling for international departures by NZ residents

3.1 The conventional OLS model

Firstly, we have developed a model using the conventional OLS approach (Equation 1) with its key statistics shown in Table 3.1.

$$Ln(PaxPC) = 1.02Ln(GDPrPC) + 0.388Ln(OZ\$\_NZ\$) - 0.701Ln(RCPIi) - 0.089SARS + 0.434 \quad \text{Equation 1 (OLS model)}$$

Where, PaxPC = international passenger departures per capita by New Zealand residents; GDPrPC = real GDP per capita; OZ$_NZ$ = exchange rate between Australian dollar and NZ$ (per NZ dollar); RCPIi = CPI for international air travel based on real airfares.

This model suggests that when New Zealand's economy improves and the New Zealand dollar becomes stronger, New Zealand residents tend to undertake more international air travel. In contrast, international airfares have a negative effect on international air travel demand. All these relationships are consistent with economic theory.

Table 3.1: Key statistics for Equation 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.434217	4.331627	0.100243	0.9213
LNRCPII	-0.701121	0.165281	-4.241986	0.0005
LNGDPRPC	1.017855	0.309204	3.291853	0.0041
SARS	-0.089412	0.048650	-1.837853	0.0826
LNOZ_NZ	0.387865	0.182012	2.130983	0.0471

R-squared	0.981407	Mean dependent var	5.744584
Adjusted R-squared	0.977275	S.D. dependent var	0.292088
S.E. of regression	0.044032	Akaike info criterion	-3.218151
Sum squared resid	0.034898	Schwarz criterion	-2.971304
Log likelihood	42.00873	Hannan-Quinn criter.	-3.156069
F-statistic	237.5242	Durbin-Watson stat	1.786491
Prob(F-statistic)	0.000000		

No heteroskedasticity problem is found with the model at the 95% confidence level by the White test (see Table 3.2). The White test is thought to be a general test for model misspecification (QMS, 2009). The Ramsey RESET test suggests that this model is stable (Table 3.3). The RESET test is also considered a general misspecification test (Song and Witt, 2000).

Table 3.2: White test for Equation 1

F-statistic	0.523794	Prob. F(9,13)	0.8329
Obs*R-squared	6.120837	Prob. Chi-Square(9)	0.7278
Scaled explained SS	1.954377	Prob. Chi-Square(9)	0.9922

Table 3.3: Ramsey RESET test for Equation 1

	Value	df	Probability
t-statistic	0.381383	17	0.7076
F-statistic	0.145453	(1, 17)	0.7076
Likelihood ratio	0.195952	1	0.6580

On the other hand, this model is associated with the collinearity issue as demonstrated by the statistics in Table 3.4. Belsley, Kuh and Welsch recommend the following procedure for collinearity testing (QMS, 2009):

- Check the condition numbers of the matrix. A condition number smaller than 1/900 (0.001) could signify the presence of collinearity.
- If there are one or more small condition numbers, then the variance-decomposition proportions should be investigated. Two or more variables with values greater than

0.5 associated with a small condition number indicate the possibility of collinearity between those two variables.

High levels of collinearity increase the errors of regression coefficients and make the coefficients unstable from sample to sample (Field, 2005). Nevertheless, the main purpose of this work is not to derive elasticities of explanatory variables, but to forecast the values of the dependent variable. If we can obtain good forecasts, the collinearity issue here will not be that important.

Table 3.4: Coefficient variance decomposition for Equation 1

Eigenvalues	18.89092	0.027041	0.002083	0.001371	5.35E-07
Condition	2.83E-08	1.98E-05	0.000257	0.000391	1.000000

Variance Decomposition Proportions

	Associated Eigenvalue				
Variable	1	2	3	4	5
C	1.000000	4.78E-07	5.02E-09	3.28E-09	1.81E-10
LNRCPII	0.954787	0.010959	0.003305	0.030943	6.42E-06
LNGDPRPC	0.994340	0.000813	0.000482	0.004361	3.73E-06
SARS	0.085167	0.057710	0.821237	0.035886	2.73E-09
LNOZ_NZ	0.198730	0.800461	9.58E-05	0.000713	3.60E-09

No autocorrelation issue is detected with this model by the Q statistics of correlogram (see Table 3.5) and the Breusch-Godfrey serial correlation LM test (Table 3.6). Presence of autocorrelation normally indicates model misspecification (Song and Witt, 2000).

Table 3.5: Q statistics of correlogram for Equation 1

	AC	PAC	Q-Stat	Prob
1	0.106	0.106	0.2914	0.589
2	-0.334	-0.349	3.3374	0.188
3	-0.235	-0.173	4.9240	0.177
4	-0.006	-0.090	4.9250	0.295
5	0.029	-0.119	4.9517	0.422
6	-0.176	-0.296	5.9999	0.423
7	0.062	0.037	6.1392	0.524
8	0.111	-0.102	6.6141	0.579
9	0.038	-0.050	6.6736	0.671
10	-0.048	-0.058	6.7760	0.746
11	-0.027	-0.021	6.8104	0.814
12	0.067	-0.005	7.0427	0.855

Table 3.6: Breusch-Godfrey serial correlation LM test for Equation 1

F-statistic	1.627805	Prob. F(2,16)	0.2272
Obs*R-squared	3.888687	Prob. Chi-Square(2)	0.1431

No normality issue of residuals is found for this model by the Jarque-Bera test (Significance value, p = 0.62).

3.2 The growth rate models

We have assessed presence of a unit root by the Augmented Dickey-Fuller (ADF), Dickey-Fuller with GLS de-trending (DFGLS), and Phillips-Perron (PP) tests. These tests indicate that all the variables have one unit root (i.e. integrated at order one, I(1)). Therefore, unit roots of all variables can be removed by the first-order differencing and a conventional OLS approach can be then applied to the differenced variables. We have obtained the following growth rate model (Equation 2) after a parsimonious process (backward stepwise elimination), with its key stats shown in Table 3.7.

$$D\big(Ln(PaxPC)\big) = 0.328D\big(Ln(US\$\_NZ\$)\big) - 0.836D\big(Ln(RCPIi)\big) - 0.107SARS - 0.124GFC + 0.0199 \quad \text{Equation 2 (Growth 1 model)}$$

Where, PaxPC = international passenger departures per capita by New Zealand residents; US$_NZ$ = exchange rate between US$ and NZ$ (per NZ dollar); RCPIi = CPI for international air travel based on real airfares; D means “Differenced”.

Table 3.7: Key statistics for Equation 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.019874	0.009811	2.025736	0.0588
GFC	-0.124011	0.041941	-2.956820	0.0088
SARS	-0.106896	0.047046	-2.272156	0.0363
D(LNRCPII)	-0.836020	0.175082	-4.775025	0.0002
D(LNUS_NZ)	0.328381	0.094319	3.481607	0.0029

R-squared	0.687800	Mean dependent var	0.032228
Adjusted R-squared	0.614341	S.D. dependent var	0.064385
S.E. of regression	0.039984	Akaike info criterion	-3.403963
Sum squared resid	0.027178	Schwarz criterion	-3.155999
Log likelihood	42.44359	Hannan-Quinn criter.	-3.345550
F-statistic	9.363075	Durbin-Watson stat	1.892625
Prob(F-statistic)	0.000345		

Diagnostic tests indicate that no statistical issues are associated with this model in terms of collinearity, autocorrelation, White stats, RESET stats and normality of residues.

We have then introduced lagged differenced variables and obtained another growth rate model (Equation 3), with its key statistics shown in Table 3.8.

$$D\big(Ln(PaxPC)\big) = 0.851D\Big(Ln\big(GDPrPC(-1)\big)\Big) - 0.417D\big(Ln(RCPIi)\big) + 0.119AirNZ\_Intl - 0.0991GFC + 0.0142 \quad \text{Equation 3 (Growth 2 model)}$$

Where, PaxPC = international passenger departures per capita by New Zealand residents; GDPrPC = real GDP per capita; RCPIi = CPI for international air travel based on real airfares; D means “Differenced” and (-1) means one step lag.

Table 3.8: Key statistics for Equation 3

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.014262	0.010673	1.336267	0.2002
AIRNZ_INTL	0.118782	0.046413	2.559266	0.0210
D(LNGDPRPC(-1))	0.851098	0.383506	2.219257	0.0413
D(LNRCPII)	-0.417049	0.195790	-2.130082	0.0490
GFC	-0.099146	0.041620	-2.382153	0.0300

R-squared	0.709907	Mean dependent var	0.036631
Adjusted R-squared	0.637383	S.D. dependent var	0.062490
S.E. of regression	0.037630	Akaike info criterion	-3.517782
Sum squared resid	0.022656	Schwarz criterion	-3.269086
Log likelihood	41.93671	Hannan-Quinn criter.	-3.463809
F-statistic	9.788660	Durbin-Watson stat	1.807606
Prob(F-statistic)	0.000335		

Diagnostic tests indicate that no statistical issues are associated with this model in terms of collinearity, autocorrelation, White stats, RESET stats and normality of residues.

3.3 The ECM models

The OLS model (Equation 1) suggests that GDP, RCPI for international air travel, and exchange rates are the significant drivers for international departures by New Zealand residents. Johansen system cointegration tests confirm that there is a cointegration relationship between them (by both the trace and maximum eigenvalue statistics at the 0.05 level).

Firstly, we have tried the Wickens-Breusch one-stage ECM approach (Song and Witt, 2000). Unfortunately, we are not able to develop satisfactory ECM models using this method. Some of them may have a good in-sample fit, but give poor out-of-sample forecasts.

We have then used the Engle-Granger two-stage ECM approach (Song and Witt, 2000), where the residues are calculated based on Equation 1 (its long-run equilibrium relationship). After a reduction process, we have obtained Equation 4, with its key statistics given in Table 3.9.

$$D\big(Ln(PaxPC)\big) = -0.568D\big(Ln(RCPIi)\big) - 0.624Residual(\text{-1}) + 0.115AirNZ\_Intl - 0.0889GFC + 0.0163 \qquad \text{Equation 4 (ECM model)}$$

Where, PaxPC = international passenger departures per capita by New Zealand residents; RCPIi = CPI for international air travel based on real airfares; D means “Differenced” and (-1) means one step lag.

Diagnostic tests indicate that no statistical issues are associated with Equation 4 in terms of collinearity, autocorrelation, White stats, RESET stats and normality of residues. Note that as lagged residue is used here as an explanatory variable (i.e. lagged dependent variable is one of the explanatory variables), Durbin-Watson statistics is no longer valid.

Table 3.9: Key statistics for Equation 4

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.016333	0.009587	1.703591	0.1067
AIRNZ_INTL	0.115004	0.048106	2.390632	0.0287
RES_L001(-1)	-0.623660	0.224786	-2.774462	0.0130
D(LNRCPII)	-0.568171	0.203248	-2.795453	0.0124
GFC	-0.088935	0.042943	-2.071000	0.0539

R-squared	0.703772	Mean dependent var	0.032228
Adjusted R-squared	0.634072	S.D. dependent var	0.064385
S.E. of regression	0.038948	Akaike info criterion	-3.456479
Sum squared resid	0.025788	Schwarz criterion	-3.208514
Log likelihood	43.02126	Hannan-Quinn criter.	-3.398066
F-statistic	10.09708	Durbin-Watson stat	1.132998
Prob(F-statistic)	0.000225		

4. Modelling for domestic air passenger departures

4.1 The conventional OLS model

Firstly, we have developed an OLS model as shown in Equation 5, with its key stats given in Table 4.1.

$Ln(PaxPC) = 3.70Ln(GDPrPC) - 0.829Ln(RCPId) - 25.1$ Equation 5 (OLS model)

Where, PaxPC = domestic air passenger departures per capita; GDPrPC = real GDP per capita; RCPId = CPI for domestic air travel based on real airfares.

Table 4.1: Key statistics for Equation 5

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-25.06412	1.713161	-14.63034	0.0000
LNGDPRPC	3.695979	0.209792	17.61737	0.0000
LNRCPID	-0.829435	0.186880	-4.438327	0.0013

R-squared	0.974056	Mean dependent var	7.500885
Adjusted R-squared	0.968868	S.D. dependent var	0.230242
S.E. of regression	0.040625	Akaike info criterion	-3.369704
Sum squared resid	0.016504	Schwarz criterion	-3.239331
Log likelihood	24.90307	Hannan-Quinn criter.	-3.396501
F-statistic	187.7250	Durbin-Watson stat	2.301427
Prob(F-statistic)	0.000000		

Diagnostic tests indicate that no statistical issues are associated with Equation 5 in terms of collinearity, autocorrelation, White stats, RESET stats and normality of residues.

4.2 The growth rate models

As with those procedures in modelling international departures, unit roots of variables are tested, and conventional OLS regressions are then applied to the differenced variables. Firstly, we have used the adjusted international trade value together with other variables and obtained Equation 6, with its key statistics shown in Table 4.2.

$$D\big(Ln(PaxPC)\big) = 0.687D(Ln(Adj\ TradePC)) - 0.4780D\big(Ln(CPId)\big) + 0.180AirNZ + 0.0102 \qquad \text{Equation 6 (Growth 1 model)}$$

Where, PaxPC = domestic air passenger departures per capita; Adj TradePC = adjusted international trade values per capita, which is calculated by multiplying the nominal trade value with a ratio of real GDP to nominal GDP; RCPId = CPI for domestic air travel based on real airfares; D means “Differenced”.

Table 4.2: Key statistics for Equation 6

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010193	0.012313	0.827840	0.4318
AIRNZ	0.179835	0.032344	5.560084	0.0005
D(LNRTRADEPC)	0.686947	0.148577	4.623490	0.0017
D(LNRCPID)	-0.478441	0.163813	-2.920657	0.0193

R-squared	0.877723	Mean dependent var	0.047723
Adjusted R-squared	0.831869	S.D. dependent var	0.085123
S.E. of regression	0.034904	Akaike info criterion	-3.611249
Sum squared resid	0.009746	Schwarz criterion	-3.449614
Log likelihood	25.66750	Hannan-Quinn criter.	-3.671093
F-statistic	19.14177	Durbin-Watson stat	1.761776
Prob(F-statistic)	0.000523		

Diagnostic tests indicate that no statistical issues are associated with this model in terms of collinearity, autocorrelation, White stats, RESET stats and normality of residues.

We have then used nominal international trade value to replace adjusted trade value and obtained the following model, with its key statistics shown in Table 4.3.

$$D\big(Ln(PaxPC)\big) = 0.824D(Ln(TradePC)) - 0.367D\big(Ln(CPId)\big) + 1.31D\big(Ln(GDPrPC, 2)\big) + 0.198AirNZ + 0.007 \qquad \text{Equation 7 (Growth 2 model)}$$

Where, PaxPC = domestic air passenger departures per capita; TradePC = international trade values per capita; RCPId = CPI for domestic air travel based on real airfares; D means “Differenced”; note that second-order difference has been applied to GDPrPC as it has two unit roots (for the data between 1998 and 2010).

Diagnostic tests indicate that no statistical issues are associated with this model in terms of collinearity, autocorrelation, White stats, RESET stats and normality of residues.

Table 4.3: Key statistics for Equation 7

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.006991	0.008098	-0.863270	0.4212
AIRNZ	0.197738	0.019050	10.37984	0.0000
D(LNTRADEPC)	0.824250	0.093353	8.829416	0.0001
D(LNRCPID)	-0.367475	0.098735	-3.721839	0.0098
D(LNGDPRPC,2)	1.307546	0.505667	2.585788	0.0414

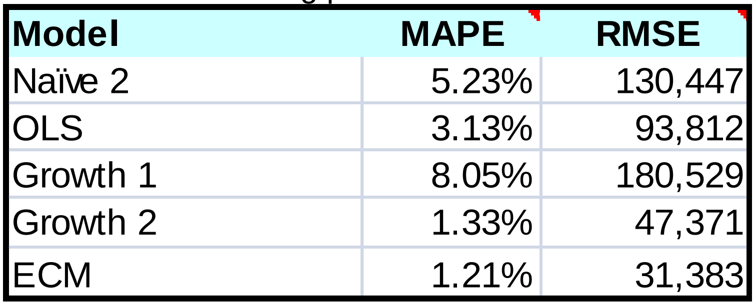
R-squared	0.968040	Mean dependent var	0.053881
Adjusted R-squared	0.946734	S.D. dependent var	0.086429
S.E. of regression	0.019947	Akaike info criterion	-4.688482
Sum squared resid	0.002387	Schwarz criterion	-4.507621
Log likelihood	30.78665	Hannan-Quinn criter.	-4.802490
F-statistic	45.43406	Durbin-Watson stat	1.503038
Prob(F-statistic)	0.000127		

5. Model evaluation

As discussed above, four models have been developed for the international passenger departures and three models for domestic air passenger departures. We have assessed the forecasting performance of these models against the 2011 – 2013 data using mean absolute percentage error (MAPE) and root mean square error (RMSE). The Naïve 2 model (simply assuming this year's growth rate is the same as last year's) is used here for comparison (benchmarking) purpose only. Where applicable, dynamic forecasts are used because this type of forecasting has to be used for the (unknown) future passenger departures.

As seen in Table 5.1, for international departures the Growth 2 model (Equation 3) and ECM model (Equation 4) have the best and similar forecasting performance. Both of them are statistically robust.

Table 5.1: Forecasting performance of the models for international departures



Model	MAPE	RMSE
Naïve 2	5.23%	130,447
OLS	3.13%	93,812
Growth 1	8.05%	180,529
Growth 2	1.33%	47,371
ECM	1.21%	31,383

Table 5.2 indicates that for domestic departures the Growth 1 model (Equation 6) has the best forecasting performance, followed by the Growth 2 model (Equation 7). Clearly, the Growth 1 model has improved largely over the OLS model in terms of forecasting power.

Table 5.2: Forecasting performance of the models for domestic departures

Model	MAPE	RMSE
Naïve 2	21.77%	2,362,891
OLS	6.66%	928,492
Growth 1	1.33%	178,088
Growth 2	4.69%	489,352

6. Air passenger departure forecasts

6.1 Setting up the scenarios

We have set up the following three scenarios for our forecasting: base case, low growth, and high growth. The 50th percentile of Statistics New Zealand's population forecasts and Treasury's forecasts on GDP, trade, and exchange rates (see Table 6.1) are used in the base case scenarios. Growth rates 30 percent lower or higher than the base case scenario are assumed in the low growth and high growth scenarios. However, exchange rates and RCPIi or RCPId are assumed to be the same in all scenarios.

Table 6.1: Forecasts of economic variables in base case scenario

Calendar Year	OZ$/NZ$	GDP (Real)	TRADE (Adjusted)	TRADE (Nominal)	RCPId (Domestic)	RCPIi (International)
	Base case scenario					
2014	0.8454	3.30%	1.55%	3.50%	0.80%	-1.00%
2015	0.8851	2.80%	3.50%	6.10%	0.80%	-1.00%
2016	0.8847	2.05%	6.70%	8.90%	0.80%	-1.00%
2017	0.8556	2.10%	6.20%	8.00%	0.80%	-1.00%
2018	0.8014	2.20%	4.80%	7.00%	0.80%	-1.00%
2019	0.8000	2.27%	3.80%	6.00%	0.60%	-0.80%
2020	0.8000	2.35%	2.50%	5.00%	0.60%	-0.80%
2021	0.8000	2.47%	2.50%	5.00%	0.60%	-0.80%
2022	0.8000	2.44%	2.50%	5.00%	0.60%	-0.80%
2023	0.8000	2.43%	2.50%	5.00%	0.60%	-0.60%
2024	0.8000	2.39%	2.50%	5.00%	0.40%	-0.60%
2025	0.8000	2.38%	2.50%	5.00%	0.40%	-0.60%
2026	0.8000	2.32%	2.50%	5.00%	0.40%	-0.60%
2027	0.8000	2.25%	2.50%	5.00%	0.40%	-0.40%
2028	0.8000	2.20%	2.50%	5.00%	0.40%	-0.40%
2029	0.8000	2.20%	2.50%	5.00%	0.40%	-0.40%
2030	0.8000	2.20%	2.50%	5.00%	0.40%	-0.40%

6.2 Forecasting international departures

Although forecasting performance of the ECM model is slightly better than the Growth 2 model, forecasts for the next few years by the ECM model appear to be a bit too ambitious. Moreover, the ECM model is more complex and more sensitive to changes in RCPIi than the Growth 2 model. We have therefore decided to use the Growth 2 model to forecast international departures by New Zealand residents – see Figure 6.1 and Table 6.2. Nevertheless, the ECM model can be an alternative.

Figure 6.1: Forecast international departures by New Zealand residents (in millions)

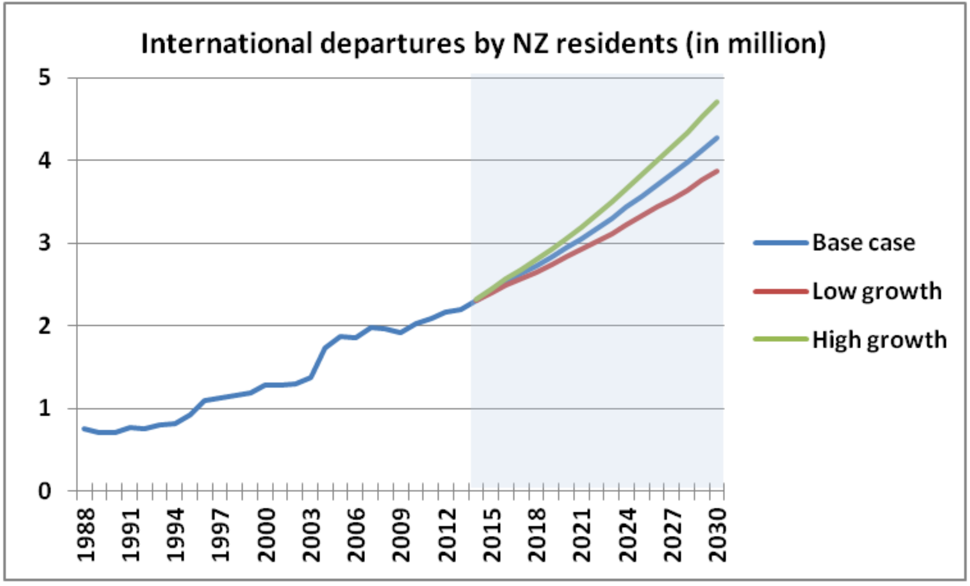


Table 6.2: Forecast growth over 2013 for international departures

(Number in millions)	Base case scenario	Low growth scenario	High growth scenario
Departures in 2013		**2.2**	
Departures in 2030	**4.3**	**3.9**	**4.7**
Growth over 2013	**94%**	**76%**	**114%**
CAGR	**4.0%**	**3.4%**	**4.6%**

Note: CAGR refers to compound annual growth rate.

If we assume all short-term foreign visitors depart from New Zealand relatively soon after arrival, we can forecast total international passenger departures. One way is to combine the results of the international departures of this model with those of MBIE's tourism forecasts for the medium-term forecasts (seven years). Another way is to combine this model's international departure forecasts with Auckland Airport's tourism forecasts for the long-term forecasts (up to 2025).

6.3 Forecasting domestic departures

The Growth 1 model (Equation 6) is used to forecast total domestic air passenger departures by both New Zealand residents and foreigners travelling within New Zealand (see Figure 6.2 and Table 6.3) as it has the best forecasting performance.

Figure 6.2: Forecast domestic departures (in millions)

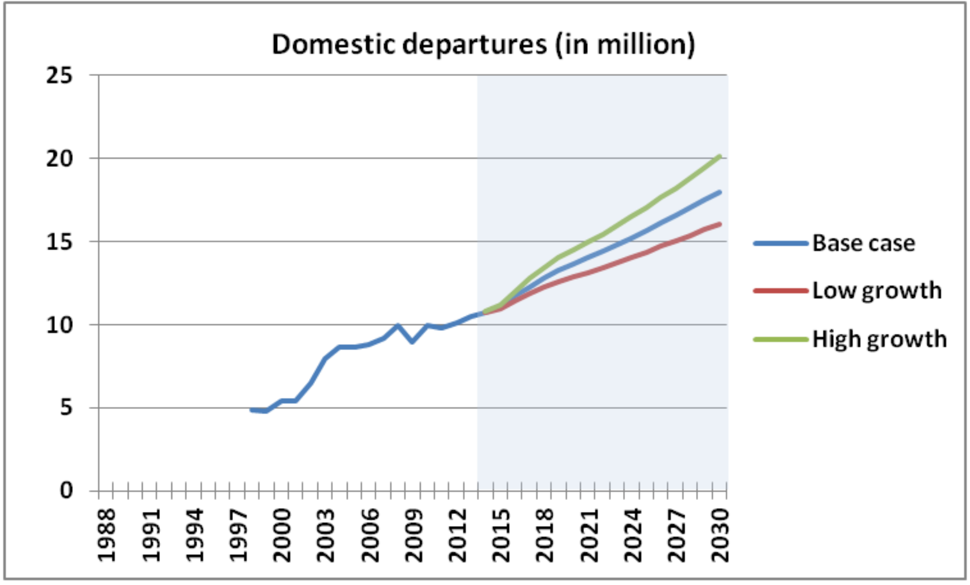


Table 6.3: Forecast growth over 2013 for domestic departures

(Number in millions)	Base case scenario	Low growth scenario	High growth scenario
Departures in 2013		**10.5**	
Departures in 2030	**18.0**	**16.1**	**20.1**
Growth over 2013	**71%**	**53%**	**91%**
CAGR	**3.2%**	**2.5%**	**3.9%**

Note: CAGR refers to compound annual growth rate.

Our forecasts are broadly consistent with relevant forecasts by other parties. For example, Auckland Airport (2014) forecasts an annual growth of 3.6% to 5.5% in international visitor arrivals to New Zealand for the period of 2014 to 2025. Tourism Research Australia (2013) forecasts that New Zealand visitors to Australia will grow by over 4% per year in the next couple of years.

6.4 Sensitivity analysis

As mentioned earlier, CPI for both international (RCPIi) and domestic (RCPId) air travel are assumed to be the same in the three scenarios. We have conducted sensitivity analysis to see how their changes would impact on the departures in the low growth or high growth scenarios (see Table 6.4).

Table 6.4: Sensitivity analysis for low growth and high growth scenarios

INTERNATIONAL DEPARTURES		
Model	Change in RCPIi	Resulted changes in departures
Growth 2 (Equation3)	±50%	±0.2% to ±2.6%
DOMESTIC DEPARTURES		
Model	Changes in RCPId	Resulted changes in departures
Growth 1 (Equation 6)	±50%	±0.2% to ±2.4%

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