CHAPTER 7

RESULTS

7.1 INTRODUCTION

In the following sections, the actual findings, resulting from the quantitative research in the form of a fixed one-way panel regression, are reported. The objective was to quantify the impact of the South African aviation policy in Africa on air passenger traffic flows. It was mentioned in the previous chapter that the impact of the aviation policy on air passenger traffic flows, as measured by the ALI index, could not be tested in isolation due to the fact that a number of identified predictors played a role. In line with this, a panel regression model was constructed which was applied to five scenarios: the intra-African market (42 countries), as well as the four regions: the SADC (13 countries), West African (17 countries), East African (seven countries) and North African (five countries) regional markets. Once the significant predictors were identified for each of the five markets, a second model was constructed to determine which of the individual provisions of the ALI have a statistically significant impact on air passenger traffic flows, taking into account the simultaneous impact of the significant predictors.

7.2 THE RESULTS OF THE PANEL REGRESSION MODEL

7.2.1 The null and the alternative hypotheses formulated for the South African – intra-African market

Null hypothesis

H_0: There is no simultaneous impact of the degree of liberalisation of air services agreements, the number of years the BASAs have been in place, the size of the GDP, the presence of a low-income country in a country-pair, the magnitude of the services trade flows and the population size on the South African – intra-African air passenger traffic flows.

Alternative hypothesis

H_1: There is such a simultaneous impact of the six predictors on air passenger traffic flows.

The null and the alternative hypotheses can be formulated for each of the four regional markets in a similar way.

7.2.2 The panel regression models

Fixed one-way panel regression was performed on 42 cross-sections or African countries over the 11 year time period. The final panel data regression model, constructed for each of the four variants of the ALI weighting system, namely *STD, 5th+, DES+* and *OWN+*, is formulated as follows:

$$ln(Traffic)_{it} = \alpha + \beta_1 ln(GDP)_{1,it} + \beta_2 (Low\_Inc)_{2,it} + \beta_3 (ASA\_age)_{3,it} + \beta_4 ln(Trade)_{4,it} + \beta_5 ln(Population)_{5,it} + \beta_6 (ALI)_{6,it} + \varepsilon_{it}$$

for $i = 1, 2, 3, \ldots, 42$

$t = 1, 2, 3, \ldots, 11.$

where ln denotes a natural logarithm,

α is a constant,

$\boldsymbol{\beta} = (\beta_1\ \beta_2\ \beta_3\ \beta_4\ \beta_5\ \beta_6)'$ is a row vector of partial regression coefficients,

ε_{it} is an error term associated with country i and year t.

As already mentioned in Chapter 6, four predictors, namely *traffic, GDP, trade* and *population*, were transformed through a natural logarithmic transformation as the distribution of these predictors was highly skewed to the left. Log transformation made the distribution more normal, enhanced the symmetry and stabilised the spread, as well as helped the predictors to fit better into the model. Similar models can be defined for each of the four regional markets, namely the SADC, West, East and North African.

7.2.3 The fit and the significance of the panel regression models

The coefficient of determination or R-square value for modelling the South African – intra-African market returned an extremely high value of 0.976, which indicated that, for all four variants of the ALI weighting system, 97.6% of the variability of air passenger traffic flows was explained by the six predictors, as mentioned in the hypotheses. The coefficient of determination was also found to be extremely high for each of the regions, irrespective of the ALI variant, as summarised in table 7.1 below. These statistics confirmed that the estimated model fits the data extremely well for all five markets, irrespective of the ALI variant used.

Table 7.1: Model fitting statistics based on the four variants of the ALI weighting system

	Coefficient of determination (R-square)			
Market	***STD***	***5th +***	***OWN+***	***DES+***
South African – intra-African (42 countries)	0.9764	0.9764	0.9763	0.9764
South African – SADC region (13 countries)	0.9142	0.9144	0.9148	0.9129
South African – West African region (17 countries)	0.9791	0.9791	0.9791	0.9791
South African – East African region (7 countries)	0.9838	0.9839	0.937	0.9839
South African – North African region (5 countries)	0.9386	0.9386	0.9386	0.9386

Source: Department of Statistics, University of Pretoria (2012)

The results of the F test, testing the significance of the panel regression model for all four variants of the ALI for the five markets, were found to be statistically significant, as summarised in table 7.2. The null hypothesis was thus rejected, indicating that there was a simultaneous impact of the six predictors on the dependent variable *ln(Traffic)* for the intra-African market, as well as for the regional markets, irrespective of the ALI variant used.

Table 7.2: F test for the panel regression model for all markets and all ALI variants

Market	ALI variant	F-value	p-value
South African – intra-African	*STD*	290.02	<.0001
	5th+	292.84	<.0001
	OWN+	300.63	<.0001
	DES+	283.06	<.0001
South African – SADC region	*STD*	52.62	<.0001
	5th+	53.90	<.0001
	OWN+	55.26	<.0001
	DES+	49.79	<.0001
South African – West African region	*STD*	103.70	<.0001
	5th+	104.01	<.0001
	OWN+	104.01	<.0001
	DES+	102.73	<.0001
South African – East African region	*STD*	154.30	<.0001
	5th+	162.59	<.0001
	OWN+	158.62	<.0001
	DES+	147.59	<.0001
South African – North African region	*STD*	18.04	<.0001
	5th+	18.31	<.0001
	OWN+	18.46	<.0001
	DES+	17.61	<.0001

Source: Department of Statistics, University of Pretoria (2012)

7.2.4 Test for a significant difference between the countries and the reference country Zambia

It was found, for all four variants of the ALI, that there were significant differences between a country in the overall South African – intra-African market and the reference country Zambia, which was selected by default as the last on the alphabetical list of countries. Table 7.3 summarises these countries for all four ALI variants. The shaded parts in the table indicate countries that differ significantly at the 5% level of significance from the reference country Zambia.

Table 7.3: Summary of the p-value of the t-test for a significant difference between a country and the reference country Zambia

Regional market	Country	p-value			
		STD	*5th+*	*OWN+*	*DES+*
SADC	Angola	0.0014	0.0018	0.0013	0.0015
	Botswana	0.2842	0.2975	0.3021	0.2768
	DRC	0.0006	0.0008	0.0007	0.0006
	Lesotho	0.9201	0.8943	0.8859	0.9233
	Madagascar	<.0001	<.0001	<.0001	<.0001
	Malawi	<.0001	<.0001	<.0001	<.0001
	Mauritius	0.675	0.7148	0.6973	0.6641
	Mozambique	0.0054	0.0075	0.0055	0.0054
	Namibia	0.1054	0.1113	0.1129	0.1041
	Seychelles	0.5701	0.6021	0.5947	0.562
	Swaziland	0.6909	0.7184	0.7207	0.688
	Tanzania	0.0001	0.0002	0.0002	0.0001
West African	Benin	<.0001	<.0001	<.0001	<.0001
	Burkina Faso	<.0001	<.0001	<.0001	<.0001
	CAR	<.0001	<.0001	<.0001	<.0001
	Cameroon	<.0001	<.0001	<.0001	<.0001
	Chad	<.0001	<.0001	<.0001	<.0001
	Congo	0.1185	0.113	0.1086	0.1179
	Gabon	0.5948	0.5703	0.5696	0.6035
	Gambia	0.0083	0.0076	0.0077	0.0084
	Ghana	<.0001	<.0001	<.0001	<.0001
	Ivory Coast	<.0001	<.0001	<.0001	<.0001
	Mali	<.0001	<.0001	<.0001	<.0001
	Mauritania	<.0001	<.0001	<.0001	<.0001
	Niger	<.0001	<.0001	<.0001	<.0001
	Nigeria	0.0391	0.0456	0.0412	0.0388
	Senegal	<.0001	<.0001	<.0001	<.0001
	Sierra Leone	<.0001	<.0001	<.0001	<.0001
	Togo	<.0001	<.0001	<.0001	<.0001
East African	Burundi	<.0001	<.0001	<.0001	<.0001
	Comoros	0.1492	0.1383	0.1387	0.1528
	Ethiopia	0.0004	0.0005	0.0004	0.0004
	Kenya	0.0028	0.0039	0.003	0.0028
	Rwanda	<.0001	<.0001	<.0001	<.0001
	Sudan	<.0001	<.0001	<.0001	<.0001
	Uganda	<.0001	<.0001	<.0001	<.0001
North African	Algeria	<.0001	<.0001	<.0001	<.0001
	Egypt	<.0001	<.0001	<.0001	<.0001
	Libya	<.0001	<.0001	<.0001	<.0001
	Morocco	<.0001	<.0001	<.0001	<.0001
	Tunisia	<.0001	<.0001	<.0001	<.0001

Source: Department of Statistics, University of Pretoria (2012)

The *p-values* of the following nine countries were found to be higher than 0.05, indicating no difference from the reference country Zambia, irrespective of the ALI variant used, as follows:

- **SADC region**
  - Botswana
  - Lesotho
  - Mauritius
  - Namibia
  - Seychelles
  - Swaziland

- **East African region**
  - Comoros

- **West African region**
  - Congo
  - Gabon

7.3 THE IMPACT OF THE SIX PREDICTORS ON AIR PASSENGER TRAFFIC FLOWS

7.3.1 The South African – intra-African market

Six predictors were identified to test the significance of their simultaneous impact on air passenger traffic flows in the context of the South African – intra-African air transport market. The results of the panel regression model, for all four variants of the ALI weighting system, represented by a full panel of 42 African countries over the 11 year time period, are provided in table 7.4 below.

Table 7.4: Panel regression results for the four variants of the ALI weighting system in the South African – intra-African market

	Partial regression coefficient				t-value				p-value			
Predictor	***STD***	***5th+***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th+***	***OWN+***	***DES+***
Intercept	-24.93	-24.00	-24.36	-25.09	-1.31	-1.26	-1.27	-1.32	0.192	0.210	0.203	0.189
LowInc	-0.09	-0.09	-0.09	-0.09	-1.19	-1.21	-1.23	-1.17	0.235	0.227	0.219	0.241
ASAage	0.02	0.02	0.02	0.01	0.67	0.70	0.71	0.66	0.501	0.483	0.476	0.513
lnTrade	**0.32**	**0.32**	**0.32**	**0.32**	**4.64**	**4.68**	**4.64**	**4.62**	**<.0001**	**<.0001**	**<.0001**	**<.0001**
lnPopulation	0.74	0.71	0.72	0.74	1.26	1.21	1.23	1.28	0.207	0.228	0.218	0.203
ALI	**0.01**	**0.01**	**0.00**	**0.01**	**2.21**	**2.26**	**2.16**	**2.27**	**0.028**	**0.025**	**0.032**	**0.024**
lnGDP	**-0.24**	**-0.24**	**-0.24**	**-0.23**	**-2.84**	**-2.88**	**-2.85**	**-2.81**	**0.005**	**0.004**	**0.005**	**0.005**

Note: The *p*-value in the table is the *p*-value of the t-test for the significance of a predictor.

Source: Department of Statistics, University of Pretoria (2012)

Only three predictors, namely the *ln(Trade)*, *ALI* and *ln(GDP),* were found to be statistically significant at the 5% level of significance, while controlling for all the other variables in the model. The impact of the predictors on *ln(Traffic)* was found to be the same for all four variants of the ALI. The partial effect of each of the three significant predictors, while controlling for all the other predictors in the model, is discussed below.

From table 7.4 it is evident that the *p-value* for the *ALI* predictor ranged between *0.024* and *0.032*, depending on the variant of the ALI weighting method applied. Thus the *ALI* predictor was found to exert a statistically significant impact on air passenger traffic flows. The positive sign of the *ALI* partial regression coefficient, ranging from 0.00 to 0.01, confirmed a positive partial impact of the *ALI* on *ln(Traffic),* while controlling for all the other variables in the model. This was in line with the expectations that liberalised agreements would lead to an increase in air passenger traffic flows. Thus, for every unit increase in the *ALI*, the *ln(Traffic)* would increase by about 1%, irrespective of the ALI weighting system used.

The *p-value* for the *ln(Trade)* predictor was less than 0.0001 for all four ALI variants, indicating that this predictor has a statistically significant impact on air passenger traffic flows. The positive sign of the *ln(Trade)* partial regression coefficient confirmed a partial positive impact of the predictor on the dependent variable, while controlling for all other

variables in the model. This was in line with the expectations that air passenger traffic flows were positively impacted by the magnitude of the services trade flows. Thus, for every unit increase in the *ln(Trade)* predictor, the *ln(Traffic)* would increase by 32%, irrespective of the ALI weighting system used.

The *p-value* for the *ln(GDP)* predictor ranged between 0.004 and 0.005, depending on the ALI variant, and was found to have a statistically significant impact on air passenger traffic flows. The negative sign of the *ln(GDP)* partial regression coefficient confirmed a partial negative impact of the predictor on the *ln(Traffic),* while controlling for all the other variables in the model. It must be noted[47] however that the partial regression coefficient for the GDP was found to be positive, in line with the assumption that the magnitude of economic activity positively impacted on air passenger traffic flows between two countries. Thus, for every unit increase in the *GDP*, the *ln(Traffic)* would increase by about 79%, irrespective of the ALI weighting system used.

The impact of six predictors on air passenger traffic flows in the South African – intra-African air transport market was discussed above. Three predictors were found to be significant for all four variants of the ALI weighting system.

7.3.2 The South African – SADC regional market

This section reports the panel regression results in the South African – SADC regional market with the objective of answering the following questions: "What are the significant predictors and how do they differ from the overall market and the other three regional markets?"

Three predictors, namely the *ln(Trade), ALI* and *ln(GDP),* were found to be statistically significant. The significant predictors and the signs of their partial regression coefficients

[47] GDP = exp(*ln(GDP*)); therefore the partial negative coefficient of the *ln(GDP)* is equivalent to exp(-0.23) = +0.79, a positive GDP coefficient.

were identical to the results of the overall market. The panel regression results for all four variants of the ALI for the SADC regional market, represented by a panel of 13 countries over the 11 year time period, are reported in table 7.5 below.

Table 7.5: Panel regression results for the four variants of the ALI in the South African – SADC regional market

	Partial regression coefficient				t-value				p-value			
Predictor	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***
Intercept	-74.40	-67.40	-71.90	-74.10	-2.26	-2.03	-2.19	-2.23	0.025	0.044	0.030	0.027
LowInc	-0.12	-0.12	-0.12	-0.12	-0.73	-0.73	-0.73	-0.74	0.464	0.464	0.467	0.459
ASAage	-0.05	-0.04	-0.05	-0.04	-1.30	-1.20	-1.27	-1.20	0.195	0.231	0.206	0.233
lnTrade	**0.69**	**0.72**	**0.70**	**0.66**	**4.85**	**5.01**	**4.94**	**4.62**	**<.0001**	**<.0001**	**<.0001**	**<.0001**
lnPopulation	1.88	1.65	1.80	1.90	1.85	1.60	1.77	1.86	0.066	0.112	0.080	0.066
ALI	**0.02**	**0.01**	**0.02**	**0.01**	**2.86**	**2.92**	**3.03**	**2.50**	**0.005**	**0.004**	**0.003**	**0.014**
lnGDP	**-0.57**	**-0.58**	**-0.57**	**-0.55**	**-3.37**	**-3.46**	**-3.41**	**-3.22**	**0.001**	**0.001**	**0.001**	**0.002**

Source: Department of Statistics, University of Pretoria (2012)

The partial effect of each of the three significant predictors, while controlling for all other variables in the model, is discussed below.

The *p-value* for the *ALI* predictor ranged between *0.003* and *0.014,* as summarised in table 7.5, depending on the variant of the ALI weighting method applied. The *ALI* predictor was found to have a statistically significant impact on air passenger traffic flows. The positive sign of the *ALI* partial regression coefficient confirmed a positive partial impact of this predictor on the *ln(Traffic)*, while controlling for all the other variables in the model. This was in line with the expectations that liberalised agreements would lead to increases in air passenger traffic flows. Thus, for every unit increase in the *ALI*, the *ln(Traffic)* would increase by between 1% and 2%, depending on the ALI weighting system used.

The *p-value* for the *ln(Trade)* predictor was less than 0.0001 for all four ALI variants, and thus the predictor was found to have a statistically significant impact on air passenger traffic flows. The positive sign of the *ln(Trade)* partial regression coefficient confirmed a partial positive impact of this predictor on the *ln(Traffic)*, in line with the expectations that air passenger traffic flows were positively impacted by the magnitude of the services trade

flows, while controlling for all other variables in the model. Thus, for every unit increase in the *ln(Trade)*, the *ln(Traffic)* would increase by between 66% and 72%, depending on the ALI weighting system used.

The *p-value* for the *ln(GDP)* predictor ranged between 0.001 and 0.002, depending on the ALI variant used. The *ln(GDP)* predictor was found to have a statistically significant impact on the *ln(Traffic)*. The negative sign of the *ln(GDP)* partial regression coefficient confirmed its partial negative impact on air passenger traffic flows, while controlling for all the other variables in the model. However, it must be noted[48] that the partial regression coefficient for the GDP was found to be positive, in line with the assumptions that the magnitude of economic activity positively impacted on air passenger traffic flows between two countries. Thus, for every unit increase in the *GDP*, the *ln(Traffic)* would increase by between 56% and 58%, depending on the ALI weighting system used.

In summary, three predictors were found to be statistically significant in the South African – SADC regional market, namely the *ln(Trade), ln(GDP)* and the *ALI*. The signs of the partial regression coefficients were in line with the expectations. The significant predictors were identical to the ones in the South African – intra-African market.

7.3.3 The South African – West African regional market

The panel regression results for all four variants of the ALI in the South African – West African regional market, represented by a panel of 17 countries over the 11 year time period, are depicted in table 7.6 below.

[48] GDP = exp(*ln(GDP)*); therefore the negative partial coefficient of the *ln(GDP)* is equivalent to exp(-0.55) = +0.58, a positive GDP coefficient.

Table 7.6: Panel regression results for the four variants of the ALI in the South African – West African regional market

	Partial regression coefficient				t-value				p-value			
Predictor	***STD***	***5th+***	***OWN+***	***DES+***	***STD***	***5th+***	***OWN+***	***DES+***	***STD***	***5th+***	***OWN+***	***DES+***
Intercept	-76.17	-76.17	-76.17	-76.32	-1.81	-1.81	-1.81	-1.81	0.073	0.0723	0.073	0.072
LowInc	-0.08	-0.08	-0.08	-0.08	-0.84	-0.87	-0.87	-0.82	0.403	0.388	0.388	0.414
ASAage	-0.03	-0.03	-0.03	-0.034	-0.67	-0.66	-0.66	-0.67	0.507	0.509	0.509	0.503
lnTrade	-0.02	-0.01	-0.01	-0.01	-0.11	-0.11	-0.11	-0.11	0.909	0.910	0.910	0.911
lnPopulation	2.48	2.48	2.48	2.48	1.86	1.86	1.86	1.86	0.067	0.065	0.065	0.064
ALI	0.00	0.00	0.00	0.00	0.69	0.66	0.66	0.73	0.490	0.508	0.508	0.464
lnGDP	0.07	0.07	0.07	0.07	0.46	0.45	0.45	0.46	0.649	0.652	0.652	0.649

Source: Department of Statistics, University of Pretoria (2012)

Although the F test confirmed that the model was statistically significant in the South African – West African regional market at the 5% level of significance, none of the specified six predictors were found to be significantly different among the countries. Therefore, the null hypothesis cannot be rejected. The significance of the model was due to the considerable differences among countries regarding air passenger traffic flows in this region.

7.3.4 The South African – East African regional market

The results for all four variants of the ALI weighting system in the South African – East African regional market, represented by a panel of seven countries over the 11 year time period, are reported in table 7.7 below.

Table 7.7: Panel regression results for the four variants of the ALI weighting system in the South African – East African regional market

	Partial regression coefficient				t-value				p-value			
Predictor	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***
Intercept	211.51	230.90	210.48	208.04	2.07	2.23	2.05	2.06	0.0422	0.029	0.044	0.044
LowInc	**-0.58**	**-0.57**	**-0.58**	**-0.58**	**-3.69**	**-3.70**	**-3.68**	**-3.71**	**0.001**	**0.001**	**0.001**	**0.000**
ASAage	0.22	0.24	0.22	0.21	1.75	1.92	1.73	1.72	0.085	0.059	0.088	0.090
lnTrade	**0.44**	**0.44**	**0.44**	**0.44**	**4.07**	**4.11**	**4.05**	**4.08**	**0.000**	**0.000**	**0.000**	**0.000**
lnPopulation	**-6.36**	**-6.92**	**-6.33**	**-6.25**	**-2.13**	**-2.29**	**-2.11**	**-2.12**	**0.037**	**0.026**	**0.038**	**0.038**
ALI	**0.01**	**0.01**	**0.01**	**0.01**	**2.73**	**2.80**	**2.64**	**2.81**	**0.008**	**0.007**	**0.010**	**0.007**
lnGDP	-0.19	-0.21	-0.19	-0.19	-1.18	-1.29	-1.17	-1.15	0.243	0.203	0.247	0.255

Source: Department of Statistics, University of Pretoria (2012)

Four predictors were found to have a statistically significant impact on air passenger traffic flows, namely the *Low_Inc*, *ln(Trade)*, *ALI* and *ln(Population).* The partial impact of the significant variables on the *ln(Traffic)* is discussed below.

From table 7.7 it is evident that the *p-value* for the *ALI* predictor ranged between *0.007* and *0.010*, depending on the variant of the ALI weighting method applied; thus the *ALI* predictor was found to have a statistically significant impact on air passenger traffic flows. The positive sign of the *ALI* partial regression coefficient confirmed a partial positive impact of the predictor on the *ln(Traffic)*, while controlling for all the other variables in the model. This was in line with the expectations that liberalised agreements would lead to increases in air passenger traffic flows. Thus, for every unit increase in the *ALI*, the *ln(Traffic)* would increase by 1%, irrespective of the ALI weighting system used.

The *p-value* for the *Low_Inc* predictor ranged between *0.000* and *0.001*, depending on the variant of the ALI weighting method applied. The *Low_Inc* predictor was found to have a statistically significant impact on the *ln(Traffic)*. The negative sign of the *Low_Inc* partial regression coefficient confirmed a partial negative impact of the predictor on the *ln(Traffic)*, in line with the expectations that the presence of a low income country in a country pair had a negative impact on air passenger traffic flows between those two countries. Thus, for every unit increase in the *Low_Inc* predictor, the *ln(Traffic)* would decrease by between 57% and 58%, depending on the ALI weighting system used.

The *p-value* for the *ln(Trade)* predictor was 0.000 for all four ALI variants. The *ln(Trade)* predictor was found to have a highly significant impact on air passenger traffic flows. The positive sign of the *ln(Trade)* partial regression coefficient confirmed a partial positive impact of the predictor on the *ln(Traffic)*, in line with the expectations that air passenger traffic flows were positively impacted by the magnitude of the services trade flows. Thus, for every unit increase in the *ln(Trade)*, *ln(Traffic)* would increase by 44%, irrespective of the ALI weighting system used.

The *p-value* for the *ln(Population)* predictor ranged between 0.026 and 0.038, depending on the ALI variant used, and thus the *ln(Population)* predictor was found to have a statistically significant impact on the *ln(Traffic)*. The negative sign of the *ln(Population)* partial regression coefficient confirmed a partial negative impact of the predictor on air passenger traffic flows, while controlling for all the other variables in the model. It must be noted[49] however that the partial regression coefficient for the *Population* was found to be positive, in line with the assumptions that the population size had a positive impact on air passenger traffic flows between two countries. Thus, for every unit increase in the *Population*, the *ln(Traffic)* would increase by 0.2%, irrespective of the ALI weighting system used.

7.3.5 The South African – North African regional market

The results for all four variants of the ALI weighting system in the North African regional market are presented in table 7.8 below. This market is represented by a panel of five countries over the 11 year time period.

[49] Population = exp(*ln*(*Population*)); therefore the negative partial coefficient of the *ln(Population)* is equivalent to exp(-6.25) = +0.002, a positive population coefficient.

Table 7.8: Panel regression results for the four variants of the ALI weighting system in the South African – North African regional market

	Partial regression coefficient				t-value				p-value			
Predictor	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***
Intercept	-135.11	-135.12	-135.12	-135.08	-1.38	-1.38	-1.38	-1.38	0.175	0.175	0.175	0.175
LowInc	0	0	0	0	.	.	.	.	.	.	.	.
ASAage	0.069	0.069	0.069	0.069	0.80	0.80	0.80	0.80	0.430	0.430	0.430	0.430
lnTrade	-0.029	-0.029	-0.029	-0.03	-0.20	-0.20	-0.20	-0.20	0.841	0.841	0.841	0.841
lnPopulation	4.39	4.39	4.39	4.39	1.53	1.53	1.53	1.53	0.134	0.134	0.134	0.134
ALI	-0.01	-0.01	-0.01	-0.01	-1.76	-1.76	-1.76	-1.76	0.086	0.086	0.086	0.086
lnGDP	**-0.35**	**-0.35**	**-0.35**	**-0.35**	**-2.13**	**-2.13**	**-2.13**	**-2.13**	**0.040**	**0.040**	**0.040**	**0.040**

Source: Department of Statistics, University of Pretoria (2012)

Six predictors were tested for their significance in terms of their partial impact on air passenger traffic flows; only one, the *ln(GDP)* was found to have a statistically significant impact on air passenger traffic flows, the partial impact of which is discussed below.

It is evident from table 7.8 that the *p-value* for the *ln(GDP)* predictor was equal to 0.040 for all four variants of the ALI, and thus the *ln(GDP)* predictor was found to have a statistically significant impact on the *ln(Traffic)*, while controlling for all the other variables in the model. The negative sign of the *ln(GDP)* partial regression coefficient confirmed a partial negative impact of the predictor on the *ln(Traffic)*. However it must be noted[50] that the partial regression coefficient for the *GDP* was found to be positive, in line with the assumptions that the magnitude of economic activity had a positive impact on air passenger traffic flows between the two countries. Thus, for every unit increase in the *GDP*, the *ln(Traffic)* would increase by 70%, irrespective of the ALI variant used.

In summary, only one of the predictors, namely the *ln(GDP),* was found to have a statistically significant impact on air passenger traffic flows in the South African – North African regional market, which paints a picture completely different to that of the South African – intra-African market, as well as to those of the other three regional markets.

[50] GDP = exp(*ln(GDP)*); therefore the negative partial coefficient of the *ln(GDP)* is equivalent to exp(-0.35) = +0.70, a positive GDP coefficient.

7.4 OVERVIEW OF THE SIGNIFICANT PREDICTORS

The previous sections discussed predictors that have a significant impact on air passenger traffic flows in the overall South African – intra-African market, as well as in the regional markets. This section provides a snapshot comparison of the significant predictors across the five different markets. The question is: "What are the main predictor commonalities and differences amongst these five markets?"

The results of the panel regression, discussed in section 7.3, confirmed that the predictors and the signs of the partial regression coefficients were the same for all four variants of the ALI weighting system. Thus, the choice of the ALI variant used is of less importance as it did not have an impact on the predictors' significance. Table 7.9 below summarises the significant predictors and their partial regression coefficients in the five markets. The partial regression coefficients presented are based on the ALI standard system.

Table 7.9: Significant predictors and the respective partial regression coefficients

Significant Predictors	Market					Partial regression coefficient				
	Intra-African	SADC region	West region	East region	North region	Intra-African	SADC region	West region	East region	North region
Ln(Trade)	X	X		X		0.32	0.69		0.44	
ALI	X	X		X		0.00	0.02		0.01	
Ln(GDP)	X	X			X	-0.24	-0.57			-0.35
Low_Inc				X					-0.58	
Ln(Population)				X					-6.4	

Source: Department of Statistics, University of Pretoria (2012)

The absence of crosses (X) in table 7.9 in the West African regional column indicates that none of the predictors were found to have a statistically significant impact on air passenger traffic flows in this market.

The *ln(Trade)* predictor was found to have a significant impact on air passenger traffic flows in the three markets, namely the intra-African market, SADC and East African regional markets. The partial regression coefficients displayed the expected sign and confirmed a positive partial impact of the predictor on the *ln(Traffic)* across the three markets. The partial impact of *ln(Trade)* was most significant in the SADC region (69% increase in *ln(Traffic)* for every unit increase in *ln(Trade*)), followed by the East African region (44%) and the intra-African market (32%).

The *ALI* predictor was also found to have a statistically significant impact in the same three markets. The partial regression coefficient sign was positive across the three markets, in line with the expectations that the degree of liberalisation or openness of BASAs had a positive impact on air passenger traffic flows. The impact of the *ALI* was found to be most significant in the SADC region (2% increase in *ln(Traffic)* for every unit increase in the *ALI*), followed by the East African region (1%) and intra-African market (0.5%).

The *ln(GDP)* predictor was found to have a statistically significant impact on air passenger traffic flows in three markets, namely the intra-African, SADC region and North African region. The negative sign of the partial regression coefficient across the three regions confirmed a partial negative impact of the predictor on the *ln(Traffic).*

The Low_Inc predictor was found to have a statistically significant impact on air passenger traffic flows only in one market, namely the East African region. The partial coefficient sign was negative, in line with the expectations that the presence of a low-income country in a country-pair had a negative impact on air passenger traffic between the country-pair. It was found that for every unit increase in the *Low_Inc* predictor, the *ln(Traffic)* would decrease by 58%.

The *ln(Population)* predictor was found to have a statistically significant impact on the *ln(Traffic)* predictor only in the East African region. The sign of the partial coefficient thus confirmed a negative impact of the predictor on *ln(Traffic)*.

The Low_Inc and *ln(Population)* were the two significant predictors unique to only one market, namely the East African region.

7.5 THE IMPACT OF THE *ALI* FEATURES ON AIR PASSENGER TRAFFIC FLOWS

7.5.1 Introduction

As discussed above, the impact of the aviation policy on air passenger traffic flows, as measured through the *ALI*, was found to be significant in the three markets, namely the intra-African, SADC and East African regional markets. The next step was to determine which of the features of the *ALI* predictor had significant partial impact on air passenger traffic flows, while controlling for all the other variables in the model. The *ALI* predictor comprises seven main features, as was comprehensively discussed in Chapter 6. These are: 1) *grant of traffic rights,* which are weighted cumulatively as they are not mutually exclusive*: a) 5th freedom traffic right*, b) *7th freedom traffic right* and c) *cabotage traffic right*; 2) *capacity*; 3) *tariffs*; 4) *withholding*; 5) *designation*; 6) *cooperative arrangements*; and 7) *statistics*.

7.5.2 Panel regression results for the two time periods

Panel regression was performed in the respective markets, taking into account only the significant predictors, summarised in section 7.4 above, and "unpacking" the individual features of the *ALI* predictor. Despite the fact that the *ALI* predictor was found to be insignificant in the North region, it was decided that for this step the partial impact of each of the individual *ALI* features on air passenger traffic flows would be tested as the *p*-value for the *ALI* was 0.086 for all four ALI variants.

It was also important to run the same panel regression on the data for the five year time period from 2006 to 2010 and to compare these results to the 11 year time period from 2000 to 2010. The five year time period from 2006 to 2010 represents the period over which South Africa embarked on the five year liberalisation campaign driven by the Airlift Strategy.

As mentioned earlier, Somalia, Zimbabwe and Liberia were excluded from the 11 year panel data set as they had missing values for some years in the selected time period. To ensure comparability of the results for the two time periods, these three countries were also excluded from the five year panel data set. *ALI* features which were constant or had a low variation within the countries were excluded from the analyses. Table 7.10 presents the panel regression output for the two time periods in each of the respective markets.

Table 7.10: Summarised panel regression results of the impact of the ALI features on air passenger traffic flows

		Partial regression coefficient				t-value				p-value			
Market	**Predictor**	***STD***	***5th +***	***OWN+***	***DES +***	***STD***	***5th +***	***OWN+***	***DES+***	***STD***	***5th +***	***OWN+***	***DES+***
	2006 - 2010												
South African — intra-African	R5th	0.04	0.02	0.04	0.04	2.04	2.02	2.02	2.03	0.043	0.045	0.045	0.044
	Capacity	0.05	0.06	0.06	0.05	2.72	2.72	2.72	2.75	0.007	0.007	0.007	0.007
	Tariff	-0.03	-0.03	-0.03	-0.03	-1.34	-1.35	-1.35	-1.34	0.181	0.178	0.178	0.182
	Withhold	-0.04	-0.05	-0.02	-0.05	-1.96	-1.90	-1.90	-1.96	0.052	0.060	0.060	0.052
	Design	-0.25	-0.28	-0.28	-0.13	-5.45	-5.45	-5.45	-5.46	<.0001	<.0001	<.0001	<.0001
	CoopArr	0.36	0.43	0.43	0.43	4.87	4.87	4.87	4.88	<.0001	<.0001	<.0001	<.0001
	2000 - 2010												
	R5th	0.03	0.01	0.03	0.03	1.49	1.48	1.48	1.49	0.138	0.138	0.138	0.138
	Capacity	0.02	0.02	0.02	0.02	1.23	1.23	1.23	1.26	0.218	0.220	0.220	0.207
	Tariff	0.00	0.00	0.00	0.00	-0.24	-0.21	-0.21	-0.23	0.807	0.834	0.834	0.815
	Withhold	-0.01	-0.01	-0.01	-0.01	-0.65	-0.65	-0.65	-0.67	0.517	0.517	0.517	0.501
	Design	0.03	0.03	0.03	0.02	1.21	1.20	1.20	1.20	0.227	0.230	0.230	0.230
	CoopArr	-0.01	-0.01	-0.01	-0.01	-0.33	-0.34	-0.34	-0.33	0.739	0.732	0.732	0.743
	2006 - 2010												
South African — SADC region	R5th	0.04	0.02	0.04	0.04	1.27	1.27	1.27	1.25	0.211	0.211	0.211	0.218
	Capacity	0.10	0.12	0.12	0.11	3.86	3.87	3.87	3.85	0.000	0.000	0.000	0.000
	Tariff	0.02	0.03	0.03	0.02	0.55	0.58	0.58	0.59	0.587	0.567	0.567	0.560
	Withhold	0.00	0.00	0.00	0.00	0.01	-0.02	-0.02	-0.05	0.996	0.984	0.984	0.962
	Design	-0.14	-0.16	-0.16	-0.07	-2.15	-2.13	-2.13	-2.15	0.037	0.039	0.039	0.037
	CoopArr	0.21	0.25	0.25	0.25	2.23	2.20	2.20	2.25	0.031	0.033	0.033	0.030
	2000 - 2010												
	R5th	0.05	0.03	0.07	0.06	2.36	2.35	2.35	2.34	0.020	0.020	0.020	0.021
	Capacity	0.11	0.13	0.13	0.12	4.85	4.82	4.82	4.87	<.0001	<.0001	<.0001	<.0001
	Tariff	-0.05	-0.06	-0.06	-0.05	-2.22	-2.13	-2.13	-2.17	0.028	0.035	0.035	0.032
	Withhold	0.04	0.04	0.02	0.04	1.52	1.53	1.53	1.48	0.131	0.130	0.130	0.141
	Design	-0.01	-0.01	-0.01	0.00	-0.18	-0.22	-0.22	-0.24	0.856	0.829	0.829	0.813
	CoopArr	-0.03	-0.04	-0.04	-0.04	-0.73	-0.75	-0.75	-0.69	0.468	0.454	0.454	0.493
	2006 - 2010												
South African — East African region	R5th	-0.03	-0.01	-0.03	-0.03	-0.94	-0.94	-0.94	-0.94	0.359	0.359	0.359	0.359
	Capacity	0.02	0.02	0.02	0.02	1.25	1.25	1.25	1.25	0.225	0.225	0.225	0.225
	2000 - 2010												
	R5th	0.01	0.00	0.01	0.01	0.26	0.26	0.26	0.26	0.792	0.792	0.792	0.792
	Capacity	0.03	0.03	0.03	0.03	1.29	1.32	1.32	1.30	0.203	0.192	0.192	0.198
	Tariff	-0.04	-0.05	-0.05	-0.05	-1.04	-1.04	-1.04	-1.04	0.301	0.301	0.301	0.301
	Design	0.18	0.20	0.20	0.09	2.74	2.73	2.73	2.74	0.008	0.008	0.008	0.008
	2006 - 2010												
South African — North African region													
	2000 - 2010												
	R5th	0.02	0.01	0.02	0.02	0.63	0.63	0.63	0.63	0.534	0.534	0.534	0.534

Source: Department of Statistics, University of Pretoria (2012)

7.5.3 The South African – intra-African market

Time period 2006 – 2010

In the 2006 – 2010 panel regression, four features of the *ALI* predictor, namely the *5th freedom traffic right*, *capacity, designation* and *cooperative arrangements*, were found to have a partial statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model.

It must be noted that, given the nature of the panel data set, it was impossible to determine which of the *ALI* sub-features had a positive impact on air passenger traffic flows. For example, the designation feature has two sub-features, the single and multiple. Seven *ALI* features were mutually exclusive in the panel data set, the impact of which could only be determined through cross-sectional studies.

The *p-value* for the *5th freedom traffic right (R5th)* ranged between 0.043 and 0.045, depending on the variant of the ALI weighting system, and thus was found to have a statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The positive sign of the *R5th* partial regression coefficient confirmed a partial positive impact of the predictor on the *ln(Traffic)*, indicating that *5th freedom traffic rights* lead to increased air passenger traffic flows between the countries. Thus, for every unit increase in the *R5th*, *ln(Traffic)* would increase by between 2% and 4%, depending on the ALI variant used.

The *p-value* for the *capacity* equalled 0.007, irrespective of the variant of the ALI weighting system, and thus was found to have a statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The positive sign of the *capacity* partial regression coefficient confirmed a partial positive impact of the predictor on the *ln(Traffic)*, indicating that an increase in the level of openness of this feature leads to increased air passenger traffic flows between the countries. Thus, for

every unit increase in the capacity, *ln(Traffic)* would increase by between 5% and 6%, depending on the ALI variant used.

The *p-value* for the *designation (Design)* was <.0001, for all four variants of the ALI weighting system, and thus the *designation* was found to have a statistically significant impact on the *ln(Traffic)*, while controlling for all the other variables in the model. The negative sign of the *Design* partial regression coefficient confirmed a partial negative impact of this predictor on the *ln(Traffic)*, thus indicating that for every unit increase in the *Design*, the *ln(Traffic)* would decrease by between 13%, if using the *DES+* variant of the ALI weighting system, and 28%, if any of the other three ALI variants are used.

The *p-value* for the *cooperative arrangements (CoopArr)* was <.0001, for all four variants of the ALI weighting system, and thus was found to have a statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The positive sign of the *CoopArr* partial regression coefficient confirmed a partial positive impact of this predictor on the *ln(Traffic)*, indicating that an increase in the level of openness of *CoopArr* leads to increased air passenger traffic flows between the countries. Thus, for every unit increase in the *cooperative arrangements*, the *ln(Traffic)* would increase by 36%, if using the *STD* variant of the ALI weighting system, and 43%, if any of the other three variants are applied.

Time period 2000 - 2010

In the 2000 – 2010 panel regression, none of the features of the *ALI* were found to have a statistically significant impact on air passenger traffic flows.

7.5.4 The South African – SADC regional market

Time period 2006 - 2010

In the 2006 – 2010 panel regression, three features of the *ALI* predictor, namely the *capacity, designation* and *cooperative arrangements*, were found to have a partial statistically significant impact on air passenger traffic flows, while controlling all the other variables in the model.

The *p-value* for the *capacity* equalled 0.000, irrespective of the variant of the ALI weighting system, and thus *capacity* was found to have a highly significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The positive sign of the *capacity* partial regression coefficient confirmed a partial positive impact of this predictor on the *ln(Traffic)*, indicating that the increase in the level of openness of the *capacity* leads to increased air passenger traffic flows between countries. Thus, for every unit increase in the *capacity*, the *ln(Traffic)* would increase by between 10% and 12%, depending on the ALI variant used.

The *p-value* for the *designation (Design)* ranged between 0.037 and 0.039, depending on the ALI variant, and thus the *designation* was found to have a statistically significant impact on the *ln(Traffic)*, while controlling for all the other variables in the model. The negative sign of the *Design* partial regression coefficient confirmed a partial negative impact of this predictor on the *ln(Traffic)*, indicating that for every unit increase in the *Design*, the *ln(Traffic)* would decrease by between 7% and 16%, depending on the ALI variant used.

The *p-value* for the *cooperative arrangements (CoopArr)* equalled 0.030, irrespective of the ALI variant, and thus the *cooperative arrangements* predictor was found to have a statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The positive sign of the *CoopArr* partial regression coefficient confirmed a partial positive impact of the predictor on the *ln(Traffic)*, indicating that an

increase in the level of openness of the *CoopArr* leads to increased air passenger traffic flows between countries. Thus, for every unit increase in the *cooperative arrangements*, the *ln(Traffic)* would increase by between 21% and 25%, depending on the ALI variant used.

Time period 2000 – 2010

In the 2000 – 2010 panel regression, three features of the *ALI* predictor, namely the *5th freedom traffic rights, capacity* and *tariffs*, were found to have a partial statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model.

The *p-value* for the *5th freedom traffic right (R5th)* equalled 0.020, irrespective of the variant of the ALI weighting system, and thus *R5th* was found to have a statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The positive sign of the *R5th* partial regression coefficient confirmed a partial positive impact of this predictor on the *ln(Traffic)*, indicating that *5th freedom traffic rights* lead to increased air passenger traffic flows between the countries. Thus, for every unit increase in the *R5th*, the *ln(Traffic)* would increase by between 3% and 7%, depending on the ALI variant used.

The *p-value* for the *capacity* was <.0001 for all four variants of the ALI weighting system, and thus the *capacity* was found to have a statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The positive sign of the *capacity* partial regression coefficient confirmed a partial positive impact of the predictor on the *ln(Traffic)*, indicating that the increase in the level of openness of this feature leads to increased air passenger traffic flows between the countries. Thus, for every unit increase in the capacity, the *ln(Traffic)* would increase by between 11% and 13%, depending on the ALI variant used.

The *p-value* for the *tariffs* ranged between 0.028 and 0.035, depending on the variant of the ALI weighting system, and thus the *tariffs* predictor was found to have a statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model. The negative sign of the *tariffs* partial regression coefficient confirmed a partial negative impact of this predictor on the *ln(Traffic)*, indicating that for every unit increase in the *tariffs*, the *ln(Traffic)* would decrease by between 5% and 6%, depending on the ALI variant used.

7.5.5 The South African – East African regional market

Time period 2006 - 2010

In the 2006 – 2010 panel regression, none of the features of the *ALI* were found to have a statistically significant impact on air passenger traffic flows.

Time period 2000 – 2010

In the 2000 – 2010 panel regression, only one feature of the *ALI* predictor, namely the *designation*, was found to have a partial statistically significant impact on air passenger traffic flows, while controlling for all the other variables in the model.

The *p-value* for the *designation (Design)* equalled 0.008, for all four variants of the ALI weighting system, and thus the *designation* was found to have a statistically significant impact on the *ln(Traffic)*, while controlling for all the other variables in the model. The positive sign of the *Design* partial regression coefficient confirmed a partial positive impact of this predictor on the *ln(Traffic)*, indicating that the increase in the level of openness pertaining to this predictor leads to an increase in air passenger traffic flows between countries. Thus, for every unit increase in the *Design*, the *ln(Traffic)* would increase by between 9% and 20%, depending on the ALI variant used.

7.5.6 The South African – North African regional market

Time period 2006 – 2010

In the 2006 – 2010 panel regression, none of the features of the *ALI* could be tested for significance as they were constant or had a low variation within the countries.

Time period 2000 – 2010

In the 2000 – 2010 panel regression, only one feature of the *ALI* could be tested; however it was found to be insignificant.

7.6 OVERVIEW OF THE SIGNIFICANT *ALI* FEATURES

The significant *ALI* features for the four markets are summarised in table 7.11 below. In summary, *capacity* was the only feature found to be significant in the South African – SADC regional market, both in the five and 11 year time periods.

In the 2006 – 2010 panel regression, three features were found to have a significant impact on air passenger traffic flows, both in the South African – intra-African market and the South African – SADC regional market. These were: *capacity, designation and cooperative arrangements.* The *5th freedom traffic right* was the only feature in the 2006 – 2010 time period that was found significant in the South African – intra-African market.

In the 2000 – 2010 panel regression, *designation* was the only *ALI* feature found to have a significant impact on air passenger traffic flows in the South African – East African regional market.

Table 7.11: Summary of the significant ALI features for the selected time periods

	***ALI* features**	
Market	**2006 - 2010**	**2000 - 2010**
South African – intra-African	*5th freedom traffic rights* *Capacity* *Designation* *Cooperative arrangements*	
South African – SADC region	*Capacity* *Designation* *Cooperative arrangements*	*5th freedom traffic rights* *Capacity* *Tariffs*
South African – East African region		*Designation*
South African – North African region		

Source: Department of Statistics, University of Pretoria (2012)

7.7 CONCLUSION

This research demonstrated that the impact of the South African aviation policy in Africa on air passenger traffic flows, as measured by the ALI index, could not be tested in isolation, due to the fact that a number of identified predictors simultaneously played a key role. The study focused on the simultaneous impact of the six identified predictors on air passenger traffic flows in the five key markets, the intra-African, SADC, West, East and North African regional markets.

The findings indicated that the predictors which were found to have a partial significant impact, while controlling for all the other variables in the model, differed in each of the markets. The results, in terms of the predictor commonalities and differences, proved to be interesting.

In those markets where the *ALI* predictor was found to be significant, the individual features of the predictor were “unpacked” and tested for their significant impact on air passenger traffic flows. To obtain a better understanding and a more detailed comparison of the results, panel regression was performed on the data set for the two time periods, namely the 2006 – 2010 and the 2000 – 2010. Once again, the impact of the significant *ALI* features on air passenger traffic flows was found to be different in each of the identified markets, presenting robust as well as several unexpected dynamics in the intra-African and regional markets.

The final chapter of this study discusses research limitations, as well as the recommendations for managerial actions, and the directions for future research.