

## CHAPTER 6

### QUANTITATIVE RESEARCH

#### 6.1 INTRODUCTION

Earlier discussions and literature reviews indicate that international air transport is regulated by an intricate web of BASAs that stipulate the ways in which air carriers supply their services, and that air policy liberalisation could be viewed as a supply stimulus which might or might not have an effect on the actual supply levels (ICAO, 2004). This was partly due to specific network characteristics as well as complex supply and demand interactions, which highlighted the fact that the relationship between aviation policy and air passenger traffic flows could also be influenced by a number of other factors, *inter alia*, the GDP, population size, common border and language. In order to achieve its third and fourth objectives, this study followed a mixed methods approach in which two phases were undertaken: the qualitative and the quantitative.

In the qualitative phase, a two-round Delphi technique was employed to ensure that the most significant and imperative factors impacting on air passenger traffic flows had been identified. The opinions of aviation experts from academia as well as the public and private sectors were sought regarding the features of BASAs and those not related to BASAs, which, as mentioned, they viewed as exerting an influence on air passenger traffic flows between country-pairs in Africa. This was essential to ensure that factors from an industry perspective as well as factors which were unique to the region were also identified.

The Delphi process generated an exhaustive list of 25 statements of factors related to BASAs and 48 statements that were not related to BASAs. The consensus level for all statements was above the 51% threshold level with the exception of the “*break of gauge provision*”. To provide a snapshot overview, these factors were subsequently plotted under factor categories identified from the literature in order to create a conceptual framework of the relevant BASA and non-BASA factors (see table 5.4). The ten main factor categories

established were: 1) *government responsibility*, which was further subcategorised into *aviation policy* and *all others*; 2) *external economic factors*; 3) *external political factors*; 4) *supply*; 5) *intangible factors*; 6) *demand*; 7) *socio-economic and geographic factors*; 8) *geo-economic factors*; 9) *external health factors*; and 10) *force majeure*. Given the importance of the aviation policy in this research, the aviation policy subcategory was further subdivided into a) *air services agreements' features* and b) *others*. The results of the Delphi were essential in bridging the gap between the literature review and the quantitative research.

In this chapter, the quantitative phase is comprehensively discussed with the aim of estimating and statistically quantifying the impact of the South African aviation policy as measured by the four variants of the ALI: namely, *STD*, *5<sup>th</sup>+*, *DES+* and *OWN+* on air passenger traffic flows in five key markets (intra-African; SADC; West African; East African and North African) over the 11 year time period, taking into account key influencing factors or predictors. The quantitative phase also aims to identify which specific provisions of the aviation policy, reflected in the respective BASAs, result in the most significant impact on air passenger traffic flows in these markets. It is expected that the results will differ in each of the identified markets.

The chapter begins with an overview of the ALI, followed by a discussion on the progress as regards the liberalisation of air services achieved in each of the five markets over the given period. The empirical model and the quantitative technique as well as the process utilised for the final selection of factors or predictors that would simultaneously be tested together with the aviation policy regarding their impact on air passenger traffic flows are the subjects of a subsequent discussion. The chapter concludes with a null and alternative hypothesis, which will be tested in the subsequent chapter.

## **6.2 AIR LIBERALISATION INDEX**

According to Jomini, Achard and Rupp (2009), there are several possible ways of quantifying the restrictiveness or liberalisation of a BASA:

- Allocating or estimating a score for various clauses of the BASAs, dependent upon the degree to which they constrain carriers' operations;
- Observing the impact of liberalised BASAs on traffic, costs and prices. The impact on prices is the most difficult to establish due to restricted access to commercially sensitive data such as airfares. Assessing the effects of changes in BASAs on traffic requires techniques that will account for extraneous effects such as economic growth; and
- Assessing the effect of regulation on economic activity and welfare.

As stated above, the objective of the quantitative approach was to statistically measure the relationship between the South African aviation policy in Africa and air passenger traffic flows from 2000 to 2010. The selected period is linked to the adoption of the Decision in 2000 and 2010, which is the final year of the air services liberalisation targets (Appendix G) with African states as stipulated by South Africa in its aviation policy. To quantify the impact of the degree of restrictiveness or liberalisation of bilaterals between South Africa and its 45 bilateral air service counterparts regarding air passenger traffic flows, the study utilises the ALI which is a measure employed to assess the degree of liberalisation of air services for passenger traffic. It forms part of the so-called QUASAR explained in the ensuing section.

### **6.2.1 ALI in the context of QUASAR**

The Quantitative Air Services Agreements Review (QUASAR) is a database developed by the WTO Secretariat which includes 1) regulatory information on BASAs and 2) scheduled air passenger traffic data. The regulatory information on BASAs is drawn from the ICAO's World Air Services Agreements Database (WASA) which contains codified summaries of the provisions of around 2 000 BASAs and covers 184 ICAO contracting states. Scheduled air passenger traffic data by city-pairs were provided by IATA for 2005 on the understanding that exact passenger numbers would remain confidential and that only

traffic ranges would be disclosed (WTO, 2006:644). It is noteworthy that IATA data are not a perfect match for the underlying regulatory regimes, but are by far the most complete traffic data set. In summary, QUASAR was constructed by the WTO Secretariat with a base year of 2005 and covers bilateral traffic between more than 180 countries (WTO, 2006).

The ALI is the main feature of the regulatory part of the QUASAR. It is an informed index of the degree of liberalisation of air services for passenger traffic, whereby different provisions pertaining to market access are weighted on the basis of their importance in removing obstacles to trade in air services according to the judgements of experts in the sector. By categorising the different provisions in BASAs and assessing them within a scoring system, the ALI provides a simple quantification of the regulatory system in place. The value of the ALI ranges between zero (for very restrictive agreements), and 50 (for very liberal ones) (WTO, 2006:12), with the most liberal agreement between countries in the European Economic Area scoring 43 points (Rousova, 2009:15). This method of measuring the restrictiveness of regulation has been proved to be consistent with results from other statistical methods such as factor and cluster analyses (Piermartini & Rousova, 2008). The seven market access provisions of the ALI, which were briefly introduced in Chapter 2, are discussed more comprehensively in the subsequent section.

### **6.2.2 Market access provisions of the ALI**

Market access rights are usually granted in exchange for similar rights by means of some agreement(s) or arrangement(s) between countries and are usually limited to scheduled international air services. The market access right fundamentally provides an opportunity to serve a market; however, it also places a limitation on market access because of its specifications. States limit market access for various reasons: to bring about some perceived balance in rights exchanged; to retain leverage for possible future exchanges; to avoid or minimise competitive impacts on their national carriers; to be precise in order to avoid misinterpretation and/or to promote or favour some market segment such as that of a particular city or national region (ICAO, 2004:4.1-2).

The ALI scoring refers to seven market access provisions or features as relevant indicators of restrictiveness or openness for scheduled air passenger services. These are (WTO, 2006:647-648):

- **Grant of rights** defines the right to carry out services between two countries. In particular, WTO has taken *fifth freedom*, *seventh freedom* and *cabotage* rights into account. More basic agreements grant “transit rights” (third and fourth freedoms). More liberal BASAs also include a *fifth freedom right*, which is the right of the designated airline to carry traffic to a third country providing that the flight originates or terminates in the partner country. Few BASAs grant the *seventh freedom right*, that is, the right to operate flights between two foreign countries without the flight originating or terminating in one’s own country. *Cabotage*, or the right of a foreign carrier to operate domestic flights, is usually excluded from BASAs (ICAO, 2004:4.1-10);
- **Designation** is the right to designate one (*single designation*) or more than one (*multiple designation*) airline to operate a service between two countries. In restrictive agreements each government allows a single airline to be the national carrier. In more liberal agreements, multiple airlines are designated to operate services between partner countries;
- **Withholding or ownership** defines the conditions required for the designated airline of the other party to have the right to operate. Restrictive conditions stipulate that the designated airlines must be “*substantially owned and effectively controlled*” by nationals, which entails that the designated airline is the “flag carrier” of the foreign country. More liberal regimes include *community of interest* and *principal place of business*;
- **Capacity clause** identifies the regime which determines the capacity (in terms of volume of traffic, frequency or regularity of service and/or aircraft type(s)) that may be carried out on the agreed services. The most commonly utilised such clauses

are: predetermination, Bermuda I and free determination. *Predetermination* is the most restrictive one and requires that the capacity is agreed prior to service commencement. *Bermuda I* provides limited rights to the airlines to determine their capacities without prior government approval, while *free determination* excludes the capacity from regulatory control;

- **Tariff approval** refers to the regime which governs the approval of the pricing of services between two countries. The most restrictive regime is *dual approval*, whereby both parties have to approve the tariff before it can become effective. Semi-liberal regimes are *country of origin* (tariffs may only be disapproved by the country of origin), *dual disapproval* (tariffs have to be disapproved by both countries to make them ineffective) and *zone pricing* (parties agree to approve prices falling within a specific range and meeting certain characteristics);
- **Statistics** provide rules on the exchange of statistics between countries or their airlines. Restrictive BASAs often contain a provision on the exchange of statistics between the signatory parties to monitor traffic or verify adherence to quantitative restrictions;
- **Cooperative arrangements** define the right of the designated airline to enter into cooperative marketing agreements such as code-sharing and alliances. More liberal BASAs tend to allow cooperative arrangements between the designated airlines such as code-sharing. The possibility of entering into cooperative arrangements confers a number of commercial advantages on the carriers concerned and is considered an indicator of relative openness in bilaterals.

### 6.2.3 Overview of South African – intra-African BASA provisions in relation to ALI

Table 6.1 provides an overview of the relevant provisions that feature in agreements between South Africa and the respective 45 African countries, based on 2010 data. **Grant**

**of rights:** *fifth freedom traffic rights* featured in 24 agreements, representing 53% of the intra-African sample. The overall liberalisation target for implementing the YD for 2010 was 65% or 34 states as determined by the Airlift Strategy for South Africa. *Seventh freedom rights* as well as *cabotage rights* did not feature in any of the 45 agreements; this was in line with the YD which did not cater for these provisions. **Withholding/ownership clause:** the most restrictive ownership clause (*substantial ownership and effective control*) was still dominant in the agreements, representing 58% of the sample; however, the remaining 42% of the agreements featured the *principal place of business clause*, which was the most liberal ownership regime. These results indicate significant liberalisation progress in terms of South African – intra-African passenger traffic as the YD caters for the *community of interest clause* which, according to the ALI weighting system, is less liberal than the *principal place of business*. **Tariffs:** only 15 agreements (33%) allowed the most liberal pricing regime (*free pricing*), with restrictive and semi-restrictive provisions still being dominant. The tariff liberalisation target for 2010 as determined by the Airlift Strategy was 85% or 45 African states. **Capacity:** the most restrictive capacity clause, *predetermination*, was included in the majority of the agreements (58%); however, the remainder of the agreements allowed for *free determination*. **Designation:** *multiple designation* was allowed for in 32 agreements (71%); whereas, the designation liberalisation target of the Airlift Strategy for 2010 was set at 97%. **Cooperating agreements** were allowed for in 60% of the agreements against the Airlift's code-share liberalisation target for 2010 which was set at 90%. **Statistical exchange** was stipulated in all 45 agreements, which is viewed as a restrictive feature.

**Table 6.1: Number of agreements by feature, based on 2010 data**

Feature	Frequency (% of total sample)	Feature	Frequency (% of total sample)
<b>Grant of rights</b>		<b>Withholding/ownership</b>	
5 <sup>th</sup> freedom	24 (53%)	Substantial ownership and effective control	26 (58%)
7 <sup>th</sup> freedom	0	Community of interest	0
Cabotage	0	Principal place of business	19 (42%)
<b>Total sample</b>	<b>45</b>	<b>Total sample</b>	<b>45</b>
<b>Tariffs</b>		<b>Capacity</b>	
Dual approval	17 (38%)	Predetermination	26 (58%)
Country of origin	2 (4%)	“Other liberal”	0
Dual disapproval	11 (24%)	Bermuda I	0
Zone pricing	0 (0%)	“Other restrictive”	0
Free pricing	15 (33%)	Free determination	19 (42%)
<b>Total sample</b>	<b>45</b>	<b>Total sample</b>	<b>45</b>
<b>Designation</b>		<b>Statistics</b>	
Single	13 (29%)	Exchange required	45 (100%)
Multiple	32 (71%)	Exchange not required	0 (0%)
<b>Total sample</b>	<b>45</b>	<b>Total sample</b>	<b>45</b>
<b>Cooperative arrangements</b>			
Not allowed	18 (40%)		
Allowed	27 (60%)		
<b>Total sample</b>	<b>45</b>	<b>Total sample</b>	<b>45</b>

Note: the frequencies of 5<sup>th</sup> freedom, 7<sup>th</sup> freedom and cabotage do not add up to 45 observations because they are independent provisions, not excluding each other. Percentages may not total 100 due to rounding.

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

#### **6.2.4 The current South African – intra-African air bilateral scene**

A more detailed examination of the BASAs between South Africa and its 45 air services counterparts revealed that these could be grouped into 14 types of agreements, defined in terms of the seven market access features. For example, 13 bilaterals (29%) were type A, entailing the following: no *fifth freedom traffic rights* allowed for, *predetermination* of capacity, *dual approval* of tariffs, *substantial and effective control* in terms of ownership, *single designation*, *exchange of statistics* and no *cooperative arrangements* allowed for. Table 6.2 provides an overview of the overall South African – intra-African bilateral



situation (based on 2010 data) in terms of the types of agreements prevailing in the market as well as a regional breakdown of each type of agreement. The regional grouping of countries is based on the methodology of the South African Department of Transport and not on the geographic location of a specific country or on its membership in the Regional Economic Communities. The 45 countries were grouped into four regions: 14 under the SADC region, 18 under the West African region, eight under the East African region and five countries under the North African region. The countries representing their respective region are summarised in section 6.5.2 below. The ALI score was assigned to indicate the degree of restrictiveness or openness of each type of agreement.

**Table 6.2: South African – intra-African types of BASAs based on 2010 data**

South African – intra-African BASAs									Distribution of BASA type per region					
Type	5th freedom	Capacity	Tariffs	Withholding/Ownership	Designation	Statistics	Cooperative Arrangements	Number of BASAs	SADC	North	West	East	Frequency (% of total sample)	ALI total
A	No	Predetermination	Dual approval	SOEC	Single	Exchanged	Not allowed	13	1	1	7	4	29%	0
B	No	Predetermination	Dual approval	SOEC	Multiple	Exchanged	Not allowed	3	1	1	1		7%	4
C	No	Predetermination	Dual disapproval	SOEC	Multiple	Exchanged	Not allowed	1		1			2%	10
D	No	Predetermination	Free pricing	SOEC	Multiple	Exchanged	Allowed	1			1		2%	15
E	No	Free determination	Dual approval	SOEC	Multiple	Exchanged	Not allowed	1	1				2%	12
F	No	Free determination	Dual disapproval	PPOB	Multiple	Exchanged	Allowed	1		1			2%	29
G	No	Free determination	Free pricing	PPOB	Multiple	Exchanged	Allowed	1				1	2%	31
H	Yes	Predetermination	Country of origin	SOEC	Multiple	Exchanged	Allowed	2	2				4%	16
I	Yes	Predetermination	Dual disapproval	SOEC	Multiple	Exchanged	Allowed	3	3				7%	19
G	Yes	Predetermination	Dual disapproval	PPOB	Multiple	Exchanged	Allowed	2	2				4%	27
K	Yes	Predetermination	Free pricing	PPOB	Multiple	Exchanged	Allowed	1	1				2%	29
L	Yes	Free determination	Dual disapproval	SOEC	Multiple	Exchanged	Allowed	1	1				2%	27
M	Yes	Free determination	Dual disapproval	PPOB	Multiple	Exchanged	Allowed	3	1	1		1	7%	35
N	Yes	Free determination	Free pricing	PPOB	Multiple	Exchanged	Allowed	12	1		9	2	27%	37

Note: Percentages may not total 100 due to rounding.

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

### 6.2.5 Variants of the ALI weighting system

In addition to the “standard” (*STD*) ALI weighting system, the WTO Secretariat has developed three more variants (*5<sup>th</sup>+*, *OWN+* and *DES+*), each providing comparably more weight to a specific market access feature: *5<sup>th</sup>+* to the granting of fifth freedom traffic rights, *OWN+* to the withholding clause and *DES+* to the designation clause; these terms are explained in the subsequent paragraph. These non-standard weighting systems aim to accommodate three specific geographic and economic situations that appear to be relatively frequent and may influence the commercial importance of the different market access features of bilaterals (WTO, 2006).

*Fifth freedom traffic rights ALI (5<sup>th</sup>+) addresses the case of those states where their geographic location may limit the scope of point-to-point traffic or where their remoteness from densely populated areas may make it difficult for them to generate sufficient demand to maintain regular services to points which can only be served by larger aircraft. For such states, it is essential to secure fifth freedom rights for their carriers as these rights will allow their airlines to combine the demand for distant destinations with that of an intermediate stop. In view thereof, the weighting system has been altered to grant more weight to fifth freedom traffic rights.*

The *withholding/ownership ALI (OWN+)* weighting system was developed to cater for cases where the liberalisation of withholding provisions is likely to be of particular importance to some states due to the ownership structure of their domestic airlines. In cases where the only airline inclined to utilise the negotiated rights is either jointly owned by a community of states or where the substantive ownership is in foreign hands, greater emphasis is placed on obtaining liberalised withholding/ownership provisions.

The *multiple designation ALI (DES+)* weighting system was devised to increase the importance awarded to the multiple designation clause. This is particularly relevant in cases where countries with more than one operating scheduled airline are likely to be interested in the right to designate more than one airline to fly on the agreed routes.

Table 6.3 summarises the weightings of the seven market access features considered in the four variants of the ALI: *STD*, *5<sup>th</sup>+*, *OWN+* and *DES+*. Each feature presents a number of alternative variants, with the exception of *grant of rights*, which is presented cumulatively.

**Table 6.3: ALI weighting system**

Features	Variants	ALI (points)			
		<i>STD</i>	<i>5<sup>th</sup> +</i>	<i>OWN+</i>	<i>DES+</i>
<b>1. Grant of rights</b>					
a. Fifth freedom rights	Not granted	0	0	0	0
	Granted	<b>6</b>	<b>12</b>	<b>5</b>	<b>5.5</b>
b. Seventh freedom rights	Not granted	0	0	0	0
	Granted	<b>6</b>	<b>5</b>	<b>5</b>	<b>5.5</b>
c. Cabotage rights	Not granted	0	0	0	0
	Granted	<b>6</b>	<b>5</b>	<b>5</b>	<b>5.5</b>
<b>2. Designation</b>	Single	0	0	0	0
	Multiple	<b>4</b>	<b>3.5</b>	<b>3.5</b>	<b>7.5</b>
<b>3. Withholding/Ownership</b>	Substantial ownership and effective control	0	0	0	0
	Community of interest	4	3.5	7	3.5
	Principal place of business	<b>8</b>	<b>7</b>	<b>14</b>	<b>7.5</b>
<b>4. Capacity</b>	Predetermination	0	0	0	0
	Other restrictive	2	1.5	1.5	1.5
	Bermuda I	4	3.5	3.5	3.5
	Other liberal	6	5	5	5.5
	Free determination	<b>8</b>	<b>7</b>	<b>7</b>	<b>7.5</b>
<b>5. Tariffs</b>	Dual approval	0	0	0	0
	Country of origin	3	2.5	2.5	2.5
	Dual disapproval	6	5	5	5.5
	Zone pricing	4 or 7	3.5 or 6	3.5 or 6	3.5 or 6.5
	Free pricing	<b>8</b>	<b>7</b>	<b>7</b>	<b>7.5</b>
<b>6. Statistics</b>	Exchanged	0	0	0	0
	Not exchanged	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>7. Cooperative arrangements</b>	Not allowed	0	0	0	0
	Allowed	<b>3</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>
<b>Maximum total ALI</b>		<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>

Source: WTO (2006:14, 658-661)

By analysing the ALI standard point allocation summarised in table 6.4 as an example, it could be determined that, cumulatively, traffic rights have been awarded the most weight at 36% or 18 cumulative points by the experts, who have deemed them to represent the essence of a BASA. Third and fourth freedom rights, the most basic access features of a bilateral agreement, have not been assigned any points in the ALI. *Fifth* and *seventh freedom* and *cabotage* have all been assigned equal points or weights. *Withholding*, *capacity* and *tariff* clauses all represent indirect ways to potentially restrict the traffic rights that were exchanged, so that the most liberal variants of each feature have been considered the second most important indicators of openness, with an individual weight of 8 points or 16%. As for the *designation*, the right to designate more than one carrier differs in importance depending on how many scheduled airlines are operating in the territories of the states concerned, but it is indicative of a pro-competitive approach and has been given 4 points or 8% in the standard weighting system. *Cooperating arrangements* and *statistics* have been weighted least, at 6% and 2%, respectively.

**Table 6.4: Relative importance of the market access features in the ALI standard system**

Features	Maximum points	Relative weight
<b>1. Grant of rights</b>	18	36%
a. Fifth freedom	6	12%
b. Seventh freedom	6	12%
c. Cabotage	6	12%
<b>2. Designation</b>	4	8%
<b>3. Withholding</b>	8	16%
<b>4. Capacity</b>	8	16%
<b>5. Tariffs</b>	8	16%
<b>6. Statistics</b>	1	2%
<b>7. Cooperative arrangements</b>	3	6%
<b>Total</b>	<b>50</b>	<b>100%</b>

Source: WTO (2006:649)

All of the features of market access have also been identified by the Delphi technique as being important factors that could have an impact on air passenger traffic flows between a country-pair.

## 6.2.6 Evaluating the YD agreement with the ALI

Based on the above discussion, the question is: How do the provisions of the YD agreement score in terms of the four variants of the ALI? The scores are presented in table 6.5 and range from 33 to 36.5 points, depending on the variant of the ALI weighting system utilised.

**Table 6.5: Scoring the YD agreement**

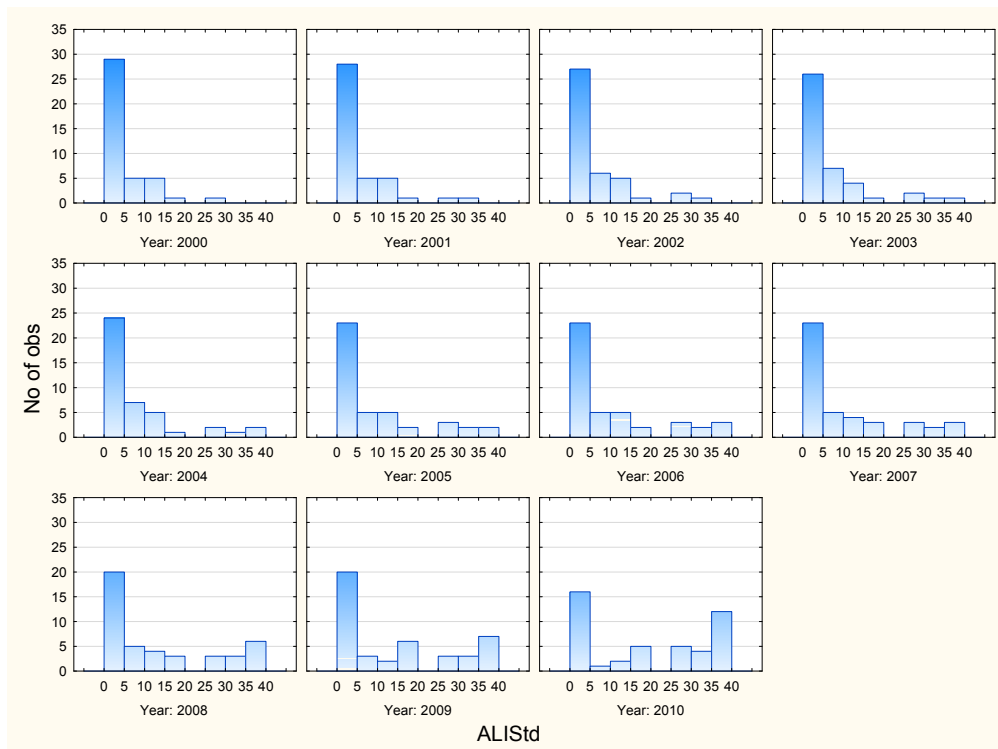
Feature	Comment	STD	5 <sup>th</sup> +	OWN+	DES+
<b>1. Grant of rights</b>					
a. 5 <sup>th</sup> freedom	Free exercise of 1 <sup>st</sup> , 2 <sup>nd</sup> , 3 <sup>rd</sup> , 4 <sup>th</sup> and 5 <sup>th</sup> freedom on scheduled and non-scheduled passenger, cargo and or/mail flights performed by an Eligible Airline to/from their respective territories (Article 3)	6	12	5	5.5
b. 7 <sup>th</sup> freedom	No provision	0	0	0	0
c. Cabotage	No provision	0	0	0	0
<b>2. Designation</b>	Multi-designation ("at least one"). Possibility to designate an airline of another party and a multinational airline (Article 6)	4	3.5	3.5	7.5
<b>3. Withholding</b>	Community of interest (Article 6.9 (g))	4	3.5	7	3.5
<b>4. Capacity</b>	Free determination (Article 5)	8	7	7	7.5
<b>5. Tariffs</b>	Free pricing, however filing is required for increases (Article 4)	8	7	7	7.5
<b>6. Cooperative arrangements</b>	Article 11.3	3	2.5	2.5	2.5
<b>7. Statistics</b>	No provision of statistics stipulated	1	1	1	1
<b>Total</b>		<b>34</b>	<b>36.5</b>	<b>33</b>	<b>35</b>

Source: Based on WTO ALI weighting system

### 6.3 DEGREE OF AIR SERVICES LIBERALISATION IN THE SOUTH AFRICAN – INTRA-AFRICAN AND THE REGIONAL MARKETS

Table 6.1 above indicated that restrictive regimes featured frequently in the design of BASAs between South Africa and its 45 bilateral counterparts in Africa, based on 2010 data. However, this information does not allow for an assessment of the overall degree of restrictiveness or openness of the BASAs or the progress (if any) made over the period studied. To obtain more clarity on this issue, an analysis of the distribution of the ALI was conducted. Figure 6.1 displays histograms for each of the 11 years. The X-axis indicates the ALI scores for the BASAs that are in place while the Y-axis represents the number of BASAs that were already in place. The ALI score is the cumulative score of the seven features of market access and is based on the ALI standard weighting system. All four variants of the ALI distribution can be found in Appendix J.

**Figure 6.1: Histograms of the degree of air services liberalisation of the South African – intra-African aviation market**



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

The histograms provide a very clear overview of the gradual liberalisation of air services agreements between South Africa and the said 45 African countries over the given period. In 2000, the year when the YD was officially adopted, the ALI scores were highly skewed to the left. As summarised in table 6.6 below, 98% of the 41 agreements that were in place scored below 20 points<sup>46</sup> in the ALI standard weighting system, indicating a very restrictive air services regime and a minimum level of air services liberalisation. In 2000, South Africa did not have an air services agreement with the following four countries: the Gambia, Libya, Liberia and Sierra Leone, thus making the sample a total of 41. The highest ALI score of 27 points in 2000 was for the bilateral agreement between South Africa and Zimbabwe. The agreement allowed for unrestricted *fifth freedom traffic rights* being exercised at points within Africa in accordance with the YD; *predetermination capacity*; *double disapproval* tariff regime; *principal place of business*; *multiple designation* and *cooperative arrangements*. The *exchange of statistics* clause was incorporated into the agreement.

**Table 6.6: Distribution of the ALI scores based on the ALI standard weighting system**

ALI score range	2000	2000, %	2006	2006, %	2010	2010,%
0-5	29	71%	23	54%	16	36%
5-10	5	12%	5	12%	1	2%
10-15	5	12%	5	12%	2	4%
15-20	1	2%	2	5%	5	11%
20-25	0	0%	0	0%	0	0%
25-30	1	2%	3	7%	5	11%
30-35	0	0%	2	5%	4	9%
35-40	0	0%	3	7%	12	27%
<b>Sample Size</b>	<b>41</b>	<b>100%</b>	<b>43</b>	<b>100%</b>	<b>45</b>	<b>100%</b>

Note: Percentages may not total 100 due to rounding.

Source: Department of Transport BASAs and MOUs (2000 – 2010)

<sup>46</sup> Agreements that reach below 20 points on the ALI system entail a very restrictive air services regime; above 20 but below 40 entail an intermediate degree of liberalisation and above 40 points entail a high degree of air services liberalisation (Piermartini & Rousova, 2009).



The five year liberalisation targets in terms of the YD implementation were launched by the South African government in 2006. The distribution of the 2006 ALI scores as depicted in figure 6.1 was skewed to the left; but, to a lesser extent than in 2000, with 83% of the BASAs below 20 points. Eight BASAs introduced an intermediate degree of liberalisation in the range of 20 to 40 points. As discussed earlier in the chapter, the YD scored 34 points in the ALI standard weighting system. Two of the bilaterals fell into the intermediate degree of the liberalisation range, namely Ethiopia and Egypt, with each scoring 35 points. The agreements that exceeded the maximum YD threshold all incorporated a *principal place of business* ownership clause, which is more liberal than the *community of interest* stipulated under the YD agreement. The highest score of 37 points was assigned to the three bilaterals between South Africa and Gabon, Sierra Leone and Uganda. All of them allowed for the exercise of intra-African *fifth freedom traffic rights, unlimited capacity, free pricing regime, principal place of business, multiple designation and cooperative arrangements*. The *exchange of statistics* was requested in these respective BASAs, indicating a restrictive approach. In 2006, the total sample was represented by 43 countries, with no existing BASA in place between South Africa and the Gambia or Liberia.

The end of 2010 marked the end of the five year liberalisation targets of the Airlift Strategy. The histogram for 2010 painted a different picture of the distribution of the ALI scores. The percentage of very restrictive agreements that fell below 20 points decreased to 53%. Twenty-one BASAs or 47% of the sample introduced an intermediate degree of liberalisation in the range of 20 to 40 points for the ALI, of which 12 bilaterals or 27% exceeded the maximum YD threshold of 34 points. All 12 were allocated 37 points in the ALI standard weighting system, which represented a growth of 267% off a very small base of three BASAs in 2006. The bilaterals were between South Africa and each of the following countries:

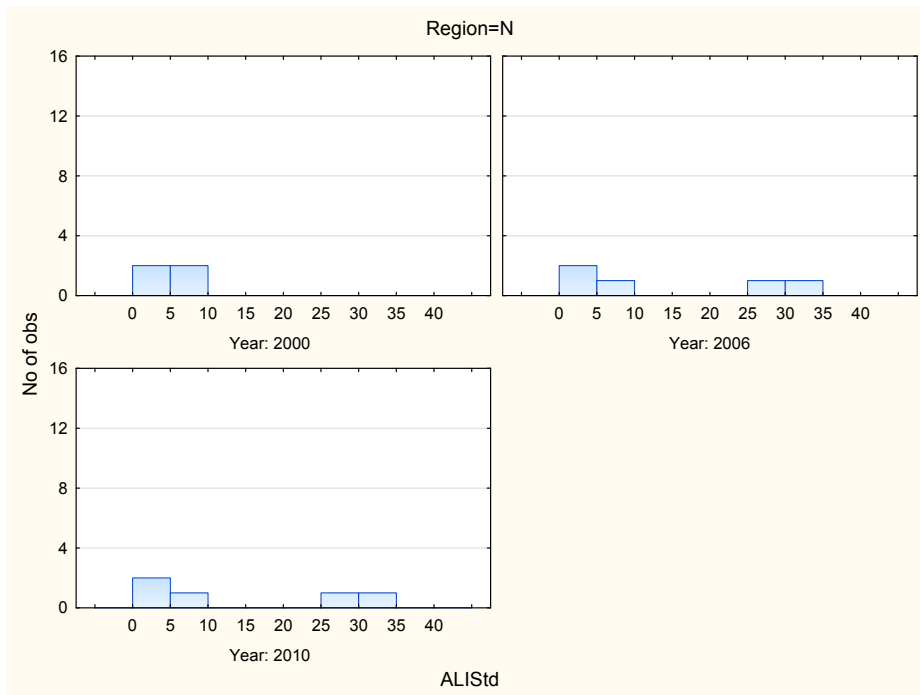
- Benin
- Cameroon
- Gabon

- Ghana
- Lesotho
- Liberia
- Rwanda
- Senegal
- Sierra Leone
- Togo
- Uganda

### **6.3.1 The depth of air services liberalisation in the four African regions**

The above histograms provided a general overview of the degree of openness or restrictiveness of the South African – intra-African bilaterals. The distributions of the ALI scores in each of the four regions were also plotted, to better understand the respective levels of gradual liberalisation achieved over the 11 year time period. Histograms in figures 6.2 to 6.5 depict the degree of air services liberalisation achieved between South Africa and the respective countries in each of the given four regions.

**Figure 6.2: Histograms of the degree of air services liberalisation of the South African – North African aviation market**

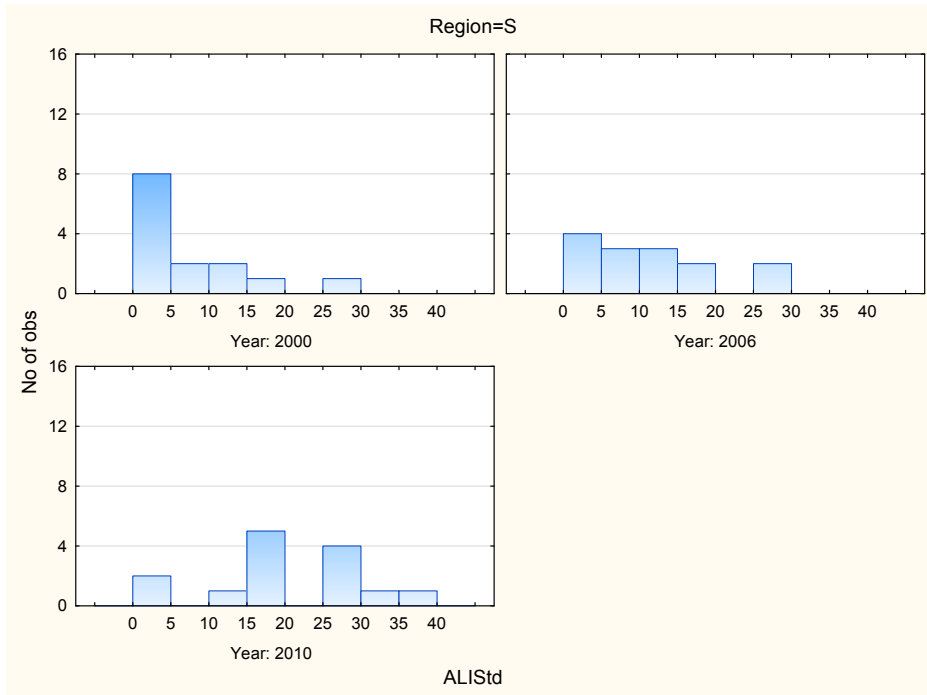


Note: There was no BASA between South Africa and Libya in 2000.

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

The total ALI score of the South African – North African bilaterals has gradually increased since the adoption of the YD in 2000: the progress was already evident in 2006. In 2000, 50% of the agreements scored below 5, and 50% below 10 points in the ALI standard weighting system, thus reflecting a very restrictive regime. In 2006, the level of restrictiveness of the agreements provided a different picture: three (60%) of the BASAs still fell into a very restrictive range of below 20 points in the ALI standard weighting system; however, two (40%) achieved an intermediate level of the degree of liberalisation in the range between 20 to 40 points. No further liberalisation was realised between 2006 and 2010. The bilateral agreement between South Africa and Egypt remained the most liberal agreement in the region in 2010 by scoring 35 points in the ALI standard weighting system.

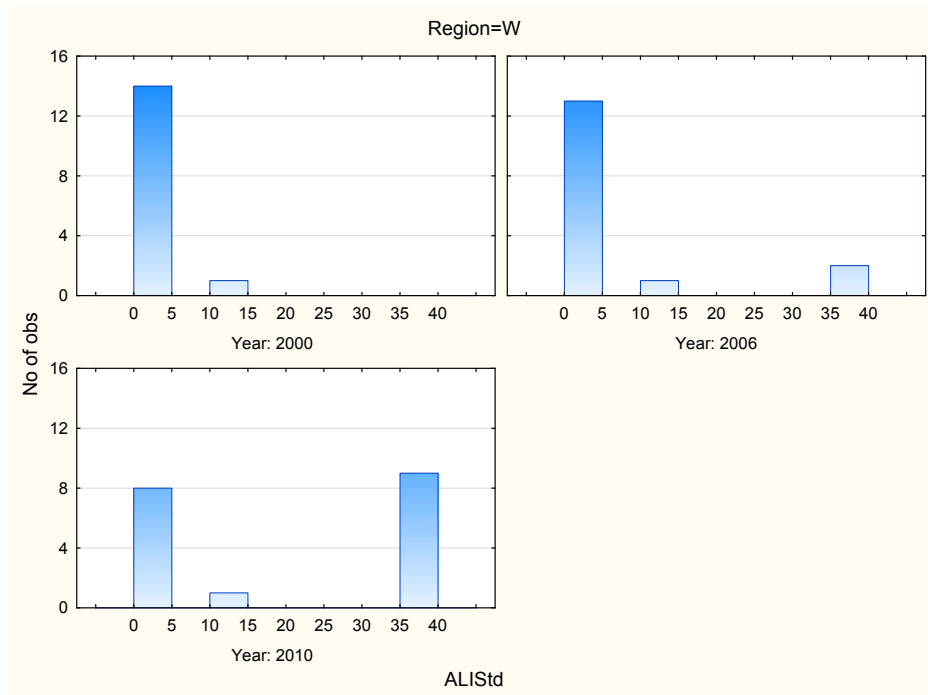
**Figure 6.3: Histograms of the degree of air services liberalisation of the South African – SADC aviation market**



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

The gradual liberalisation of the South African – SADC bilaterals over the 11 year time period is clearly visible in figure 6.3. The ALI scores were highly skewed to the left in 2000, with only one bilateral falling into an intermediate level of air services openness, above 20 points on the ALI scale. In 2006, the distribution of the ALI scores was less skewed to the left and indicated the positive progress realised in terms of gradual liberalisation. In 2010, eight BASAs fell into a very restrictive range of under 20 points; however, seven (43%) BASAs introduced an intermediate level of liberalisation, in the range between 20 and 40 points in the ALI standard weighting system. In 2010, bilateral agreements between South Africa and Botswana, as well as those between South Africa and Lesotho, exceeded the maximum YD threshold of 34 points.

**Figure 6.4: Histograms of the degree of air services liberalisation of the South African – West African aviation market**

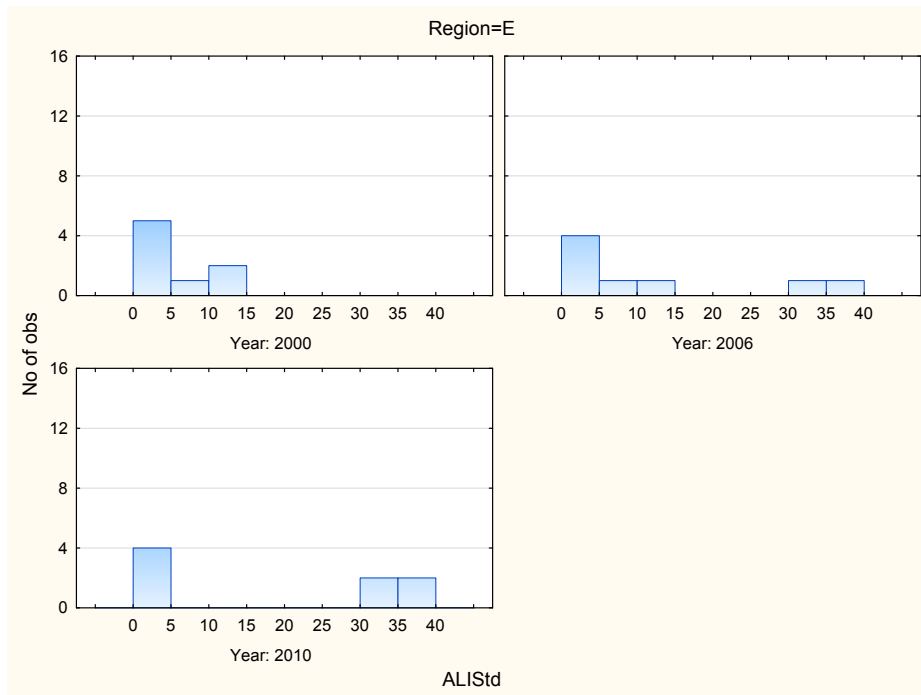


Note: BASAs between South Africa and Sierra Leone, the Gambia and Liberia were signed in 2006, 2008 and 2010, respectively.

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

The liberalisation dynamics of the South African – West African bilaterals are very different to those achieved in the SADC and North African regions. In 2000, the distribution of the ALI scores was very highly skewed to the left, with 93% of the agreements falling below the 5 point range on the ALI scale, indicating an extremely restrictive regime over that period. In 2006, most of the bilaterals fell into the very restrictive range of below 20 points in the ALI standard weighting system; however, two BASAs fell into the intermediate range of air services liberalisation, scoring 37 points on the ALI scale and exceeding the maximum YD threshold. By 2010, liberalisation dynamics had reached a very positive trend: only eight bilaterals (44%) had fallen below 5 points on the ALI scale, with one bilateral agreement in the 15 to 20 point range, and with 50% of BASAs scoring 37 points on the ALI scale (in comparison to two in 2006) and exceeding the maximum YD threshold. The ALI scores were evenly distributed between the very restrictive regime and the intermediate level of liberalisation as depicted in figure 6.4.

**Figure 6.5: Histograms of the degree of air services liberalisation of the South African – East African aviation market**



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

The liberalisation dynamics of the South African – East African bilaterals in 2000 were very similar to those in the West African region, with the ALI scores highly skewed to the left. All eight BASAs fell into the very restrictive range of below 20 points in the ALI standard weighting system. Some improvements were evident in 2006, with 25% of the bilaterals falling into the intermediate level of liberalisation in the range between 20 and 40 ALI points. The bilateral between South Africa and Ethiopia scored 35 points in the ALI system, with the one between South Africa and Uganda scoring 37 points in the ALI standard weighting system, both exceeding the maximum YD threshold of 34 points. In 2010, the liberalisation picture was different and displayed very positive trends in terms of the progress that had been realised. Four BASAs (50%) achieved an intermediate level of liberalisation on the ALI scale. The bilaterals with Uganda, Rwanda and Ethiopia exceeded the maximum YD threshold. The bilateral agreement between South Africa and Kenya only reached 31 points as the agreement did not allow for an intra-African *fifth freedom* traffic right.

### 6.3.2 The impact of a country's level of income on the South African – intra-African air services liberalisation

Following the research of Piermartini and Rousova (2008 and 2009), which found that the higher the income of the countries, the more liberal the agreements signed between the countries tended to be, this study also investigated the extent of BASA liberalisation between countries with different levels of income in order to determine whether the global experience was similar to that of the South African – intra-African air transport market. The grouping of the countries by level of income in table 6.7 is in line with the World Bank definition (World Bank, 2010).

**Table 6.7: Country grouping based on the level of income, 2010 data**

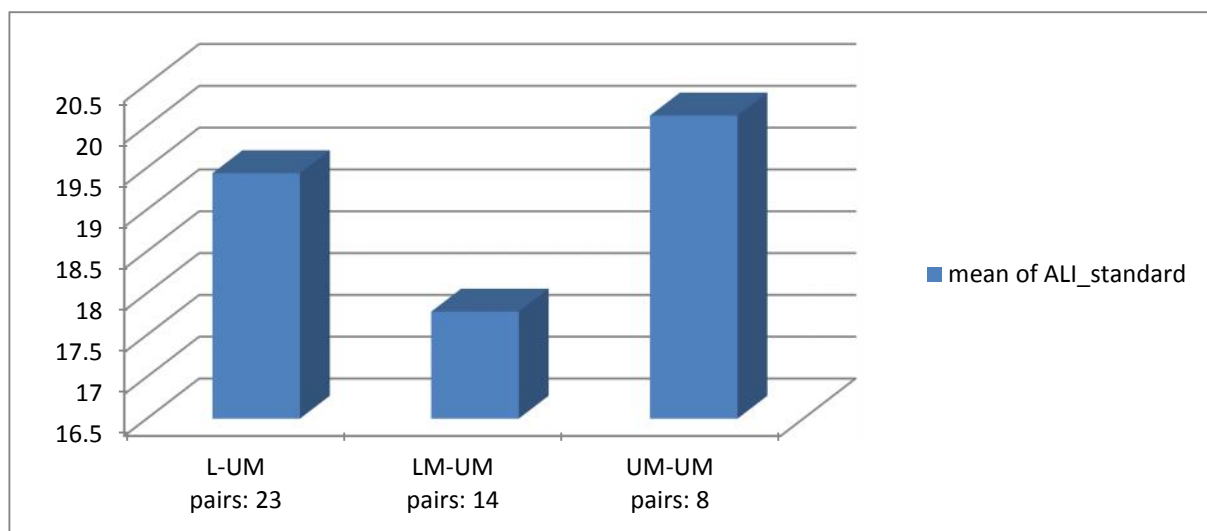
Low income (L)	Lower middle income (LM)	Upper middle income (UM)
Benin	Angola	Algeria
Burkina Faso	Cameroon	Botswana
Burundi	Congo	Gabon
Central African Republic	Ivory Coast	Libya
Chad	Egypt	Mauritius
Comoros	Ghana	Namibia
Democratic Republic of Congo	Lesotho	Seychelles
Ethiopia	Mauritania	South Africa
Gambia	Morocco	Tunisia
Kenya	Nigeria	
Liberia	Senegal	
Madagascar	Sudan	
Malawi	Swaziland	
Mali	Zambia	
Mozambique		
Niger		
Rwanda		
Sierra Leone		
Somalia		
Tanzania		
Togo		
Uganda		
Zimbabwe		

Source: World Bank (2010)

Based on the mean ALI scores of the standard variant, figure 6.6 reveals that the agreements tend to be more liberal between South Africa and 23 low income countries

than between South Africa and 14 lower middle income countries, a finding which differs from those of Piermartini and Rousova (2008 and 2009). The ALI average for the LM-UM group was negatively impacted by the four very restrictive BASAs between South Africa and Ivory Coast, Mauritania, Morocco and Sudan; all of which scored 0 points in the ALI standard weighting system. The restrictive nature of these bilaterals impacted on the liberalisation average of the LM-UM group and could be viewed as the principal reason for its deviation from the worldwide results.

**Figure 6.6: South African – intra-African air services liberalisation by income level**



Sources: Department of Transport BASAs and MOUs (2000 – 2010); World Bank (2010)

The highest degree of liberalisation was achieved by the eight countries in the upper middle income group. It was expected, in line with the findings of Piermartini and Rousova (2008 and 2009), that the level of liberalisation of the air services regime would be directly proportionate to the level of income of the countries. However, the results for South Africa and its 45 bilateral air counterparts are slightly different from the world average.

### **6.3.3 Services liberalisation based on regional grouping and level of income**

To sum up, gradual liberalisation over the 11 year period between South Africa and its African counterparts is clear from the above figures and discussion, with varying degrees of liberalisation being achieved in each of the four regions. Significant progress has been



realised with 15 BASAs, as summarised in table 6.8, the total ALI scores of which exceeded the maximum threshold for the YD.

**Table 6.8: The most liberal bilaterals in the South African – intra-African context**

Country	Region	ALI Total	Level of income
Benin	West	37	L
Botswana	SADC	35	UM
Cameroon	West	37	LM
Egypt	North	35	LM
Ethiopia	East	35	L
Gabon	West	37	UM
Gambia	West	37	L
Ghana	West	37	LM
Lesotho	SADC	37	LM
Liberia	West	37	L
Rwanda	East	37	L
Senegal	West	37	LM
Sierra Leone	West	37	L
Togo	West	37	L
Uganda	East	37	L

Note: Although Kenya and Libya agreed to implement the principles of the YD with South Africa, they did not attain the YD threshold as there was no provision for the 5<sup>th</sup> freedom rights in their BASAs in 2010, while in the case of Libya a dual disapproval tariff regime was in place which is not in line with the YD.

Source: Department of Transport BASAs and MOUs (2000 – 2010)

As evident from table 6.8 above, the extent of liberalisation is linked more closely to the regional groupings and the location of the country, but, to a lesser extent, to the level of income. The most liberal agreements that have exceeded the YD threshold stem predominantly from the West African region (60% of the 15 BASAs), followed by the East African region (20%), SADC (13%) and the North African region (7%).

#### **6.4 AIR SERVICES LIBERALISATION AND AIR PASSENGER TRAFFIC**

The impact of liberalisation on an implementing country is significant; however, comparatively few quantitative and economic exercises have been carried out to determine the impact of air transport regulation. As pointed out by the WTO (2006:10), the

literature on air transport contains no comprehensive analysis on the degree of liberalisation of BASAs. Since the introduction of the QUASAR by the WTO in 2006, the ALI index has been utilised in several studies to quantify the restrictiveness or openness of an air transport regime. In secondary literature, liberalisation changes are assessed in many ways. The literature refers to assessment in terms of comparing pre- and post-liberalisation data, for example comparing the situation in more liberal versus more restricted cases; using country specific case-studies; and using the time series, where panel and cross-sectional data are applied to a series of variables and are subsequently utilised to analyse passenger and price, cost or investment changes. Table 6.9 below summarises the empirical research which incorporates the ALI and liberalisation indices that were utilised to measure the impact of liberalisation or air policy regime changes on air passenger traffic.

**Table 6.9: Secondary literature review pertaining to the ALI and liberalisation indices**

Author	Index	Data type	Sample size	Region	Empirical model	Findings
Myburgh <i>et al.</i> (2006)	A dummy for the period, when routes are governed by largely liberalised BASA	Panel data	445 observations	SA-SADC; SA-Africa (outside SADC); SA-Europe; SA-Asia	Gravity-type model	Liberalised agreements had increased passenger volumes by 23%
InterVISTAS-ga <sup>2</sup> Consulting, Inc. (2006)	5 variables pertaining to BASA were assigned an index (1 restrictive provision, 0 liberal)	Time series and cross-sectional data	1 400 country-pairs, 810 observations	World, not broken down per region	Gravity-type model, incorporating dummy variable for each type of the restriction	Artificial constraints posed by BASA constrain the growth of traffic
Warnock-Smith and Morrell (2008)	Unique air policy index (0, 0.5 or 1 per five economic levers)	Panel data and time series	3 country-pairs over 11 years = 33 observations	US-Caribbean	Multivariate model incorporating unique liberalisation index	Positive statistical relationship between air policy reform and traffic growth
Piermartini and Rousova (2008) and (2009)	ALI	Cross-sectional	2 300 country-pairs, 1 294 observations	184 different countries	Gravity-type model, incorporating ALI	Found positive and robust evidence between the volumes of traffic and the degree of liberalisation

Author	Index	Data type	Sample size	Region	Empirical model	Findings
						of aviation market
InterVISTAS-EU Consulting, Inc. (2009)	5 variables pertaining to BASA were assigned an index (1 restrictive provision, 0 liberal)	Time series and cross-sectional data	800 country-pairs,	World, not broken down per region	Gravity-type model, incorporating dummy variable for each type of the restriction	Artificial constraints posed by BASAs constrain the growth of traffic; liberalisation of market access is projected to increase passenger traffic by 27%
Jomini <i>et al.</i> (2009)	ALI	Cross-sectional	266 observations	Routes pertaining to Istanbul declaration	Quantifying the liberalness of routes, pertaining to the Istanbul declaration	Projection of passenger increase based on successful implementation of Istanbul declaration in terms of ALI scores.
Grosso (2008) and (2010)	ALI	Cross-sectional	647 observations	Within and outside APEC	Gravity-type model employing ALI	Ease of air transport restrictions to double the ALI scores, both within and outside the APEC region would result in traffic increase by 4.5%

In this study the simultaneous impact of several key factors or predictors, one of which is aviation policy, on air passenger traffic flows, is statistically tested over an 11 year time period in the five air transport markets: the intra-African; SADC, West, East and North African markets. In addition, the impact of the aviation policy, as well as its individual provisions, is assessed by the ALI over the selected time period which has not previously been explored in secondary research. The main contribution of this study to existing literature is discussed below.

#### **6.4.1 The study's contribution to existing literature**

This study further expands on the existing research, which was predominantly cross-sectional and focused on numerous country-pairs worldwide. With the exception of research by Grosso (2008 and 2010) and Myburgh *et al.* (2006), prior studies did not focus on regions. Myburgh *et al.* (2006) focused on South Africa – SADC country-pairs over a period of six years on a quarterly basis, with a sample of 384 observations for SA – SADC. Their model utilised a dummy variable to indicate the period when the routes were governed by a largely liberal BASA.

The current research was motivated by the scarcity of empirical evidence on the impact of liberalisation between South Africa and its African air services counterparts. The most important innovation of the current research compared to that of Myburgh *et al.* (2006), is the use of the ALI to quantify the degree of restrictiveness or openness of BASAs between South Africa and 45 African countries covering the given period. This approach provides a detailed analysis of the level of liberalisation by investigating the overall South African – intra-African sample as well as each of the four regions. To the knowledge of the researcher no similar research has been conducted in the African context. The study therefore contributes to the body of knowledge as well as to the industry by:

- Expanding on the cross-sectional 2005 QUASAR database pertaining to the South African – intra-African bilaterals. The relevant BASAs and MOUs covering the period investigated were collected from the South African Department of Transport to create a unique set of panel data. This data set could be utilised to assess the restrictiveness or openness of air services regime at any point in time over this period (the target population and panel data are discussed in more detail in sections 6.5.1 and 6.6.2 below). This valuable information could also be utilised by the decision makers, particularly at the DOT, to see what progress has been realised in terms of the liberalisation of air services agreements in line with the YD and the Airlift liberalisation targets;

- Evaluating BASAs between South Africa and 45 African countries to provide an overview of the types of agreements that are in place in the intra-African market as well as in each of the four regions; and
- Statistically testing the impact of the aviation policy as measured by the ALI, and the individual provisions of market access features of the ALI on air passenger traffic flows, the results of which will be discussed in Chapter 7.

The subsequent sections describe the methodology used to determine the relationship between the South African aviation policy in Africa and air passenger traffic flows between 2000 and 2010. In particular, the overall impact of the South African aviation policy in Africa and each of the four regions as well as the impacts of the individual provisions of the policy are measured. The discussion begins with the sampling, followed by the panel data set compiled for this study, the empirical model utilised to statistically measure the simultaneous impact of the aviation policy and the identified key factors or predictors on air passenger traffic flows.

## **6.5 SAMPLING**

This section defines the target population for the quantitative phase, describes the sampling method utilised in the form of a census, and provides the details of the census that was undertaken. The implications of applying the census as the sampling method for this study are also briefly discussed.

### **6.5.1 Target population**

The target population was defined as all the relevant BASAs as well as the MOUs between South Africa and the respective African countries over a period of 11 years. Forty-five African countries had an existing signed BASA with South Africa over the selected time period. This period was selected to measure the impact of the South African aviation policy in Africa on the respective air passenger traffic flows: the said policy in Africa is linked to

the implementation of the YD, which was enforced in 2000. The BASAs, without which the quantitative research would have not been possible, as well as the MOUs pertaining to the BASAs for the selected time period, were physically collected by the researcher from the Department of Transport. Data collection took place from February to May 2011 and involved several consultations and discussion meetings with the civil aviation experts at the Department.

### 6.5.2 Sampling method

In order to collect accurate data, all the elements in a population must be examined. When data is collected from the entire population, it is referred to as a *census*. It is evident that the population for this study was small, represented by only 45 African countries. As the data could be collected from the entire population, there was no need to draw a sample and a census was considered feasible for this study (Cooper & Schindler, 2003:181).

The respective countries are summarised per region in table 6.10. The regional grouping is based on the methodology of the South African DOT, not on the geographic location of a specific country or its membership in the regional economic communities or groupings.

**Table 6.10: Quantitative census**

<b>SADC region</b>	<b>West region</b>	<b>East region</b>	<b>North region</b>
Angola	Benin	Burundi	Algeria
Botswana	Burkina Faso	Comoros	Egypt
Democratic Republic of the Congo	Cameroon	Ethiopia	Libya
Lesotho	Central African Republic	Kenya	Morocco
Madagascar	Chad	Rwanda	Tunisia
Malawi	Congo	Somalia	
Mauritius	Cote d'Ivoire	Sudan	
Mozambique	Gabon	Uganda	
Namibia	The Gambia		
Seychelles	Ghana		
Swaziland	Liberia		
Tanzania	Mali		

SADC region	West region	East region	North region
Zambia	Mauritania		
Zimbabwe	Niger		
	Nigeria		
	Senegal		
	Sierra Leone		
	Togo		

Source: Sithole (2012)

There was no sampling error because the realised sample was treated as a census. Therefore, it was not necessary to carry out a statistical evaluation of the sampling error, as “true” population values were reflected because the data could be collected from the entire population.

## 6.6 DATA ANALYSIS

### 6.6.1 Introduction

In general, given a set of variables, four basic kinds of data can be distinguished according to a) whether the variables concerned are measured once or repeatedly and b) whether the same or different units are studied in each case as depicted in table 6.11 (Diamantopoulos & Schlegelmilch, 2004:7).

**Table 6.11: Types of data set**

Units studied	Points in time for observations	
	One	Many
Same	<i>Cross-sectional data</i>	<i>Panel data</i>
Different	<i>Cross-sectional replication</i>	<i>Time-Series data</i>

Source: Diamantopoulos and Schlegelmilch (2004:7)

Data are termed “panel data” or “true longitudinal data” when the same units of analysis are studied over different points in time. In addition to capturing aggregate changes over time, panel data enable inferences to be drawn pertaining to changes in individual

behaviour (Diamantopoulos & Schlegelmilch, 2004:7). Panel data may be contrasted with pure cross-sectional data, where observations on individual units at a point in time are made, or with pure time-series, where independent observations are collected over a period of time (Nerlove, 2000:3).

The advantage of using panel data is that one is able to inspect it for inconsistencies in responses, unlike cross-sectional data where no tests can be made and users thus have no choice but to accept the reported values. If inconsistencies are ignored, however this poses the same threat as with pure time-series or cross-sectional estimations.

The concepts of panel data, fixed effect regression methods, gravity-type models and the empirical model are comprehensively discussed in the ensuing section.

### **6.6.2 Panel data set for this research**

Panel data are of special importance to research in developing countries, as they may not have a long tradition of statistical data collection: for which it is therefore generally necessary to obtain original survey data in order to answer many significant questions (Baltagi, 2001:5). This was also relevant to the current study as the raw data pertaining to the market access features of BASAs were not publicly available. The South African Department of Transport kindly granted the researcher access to the BASAs and MOUs.

By the end of 2010, there were 53 internationally recognised states in Africa, 45 of which had a BASA with South Africa. The sample size was limited to the number of African states meeting this criterion. Panel data for the given time period allowed for a maximum of 495 observations.

For this study it was important to establish whether any progress had been made in terms of the liberalisation of BASAs over this period both in line with the YD and the objectives of the South African Airlift Strategy. Four steps were followed in compiling the panel data set: 1) collection of BASAs and MOUs pertaining to those agreements that covered the period



of the research; 2) identification of variables to be included in the panel data set; 3) assigning ALI points to each of the market features; and 4) the collection of data pertaining to the remainder of the identified variables.

Step 2 generated a list of one dependent variable (*air passenger traffic flows or traffic*) and 12 explanatory variables: *GDP, population, distance, border, colony, language, low income, ASA age, Partner Island, Report Island, Trade and ALI*. The variables are discussed in detail in section 6.6.5 below.

In step 3 the researcher had to go through every document collected from the Department of Transport to assign points to each of the seven market access features for every year. Any unclear wording or sections of the documents were checked with the BASA expert at the DOT to ensure exact allocation of the scores.

The data for the other variables in the panel set were readily available. The variables and data sources are discussed later in this chapter. The output of four steps was the compilation of four panel data sets representing four variants of the ALI, namely *STD*, *5<sup>th</sup>+*, *OWN+* and *DES+*.

From an analysis point of view, it was important to select an approach which would cater for the change in dynamics over time and allow the quantification of the restrictiveness or openness of the aviation policy through examining the design of BASAs. A bilateral agreement reflects every aspect of the aviation policy of each member of the country-pair. In selecting the measurement instrument the cross-sectional approach was considered, but this approach does not address the time factor. In the case of aviation policy through the design of the respective BASAs, this is a very important aspect to factor in, as the amount of time needed for a market to respond to changes in the underlying regulatory approach could range from a few months to several decades (InterVISTAS-ga<sup>2</sup> Consulting, Inc., 2006:62). Furthermore, the cross-sectional approach does not consider the lengthy history of the relationship. In contrast, the panel data set compiled for the study

incorporated an explanatory variable to account for the number of years a particular agreement has been in place.

In addition to the above, the advantages of using panel data as opposed to cross-sectional or time-series data relevant to this research, as summarised by Baltagi (2001:5), are:

- Panel data analyses can produce more reliable parameter estimates and are less likely to be plagued by the problem of autocorrelation that is common in time-series studies;
- Panel data estimations allow the researcher to control for heterogeneity between units, which were represented by 45 cross-sections or African states in this research;
- Panel data are better able to identify and measure the effects that are not detectable in pure cross-sectional or pure time-series data.

The Department of Statistics of the University of Pretoria captured and analysed the data using the statistical computer package SAS, and advised on the relevant steps and techniques to be utilised in response to the guidelines provided by the researcher, taking into account the nature of the data collected and its limitations.

Three countries: namely, Liberia, Somalia and Zimbabwe had several years of missing data and were therefore omitted from the regression analysis. The final regression output contained 42 cross-sections using a fixed one-way panel regression technique.

### **6.6.3 Fixed effect regression methods**

Fixed effects (FE) regression methods are employed to analyse the relationship between a dependent variable (*traffic*) and predictors such as the *GDP*, *population*, *trade*, *ALI*, *Low income* and *ASA age* within an African state in the panel data set. They have the attractive feature of controlling for all stable characteristics of the states, whether measured or not.

This is accomplished by using only within-state variations to estimate the regression coefficients.

There are two basic data requirements for using the fixed effects methods. Firstly, the dependent variable, which is *traffic*, must be measured for each African state on at least two occasions. Those measurements must be directly comparable: that is, they must have the same meaning and metric. Secondly, the predictor variables of interest must change in value across those two occasions for some substantial portion of the sample (Allison, nd:1).

The fixed one-way panel regression technique was selected to account for 42 cross-sections or panels over the specific period. The model considered each country-pair as an independent entity, where its traffic would not be affected by changes in other country-pairs. The observations within each panel were dependent, but independent of the other panels or African states. The Ordinary Least Squares method that was employed in numerous cross-sectional studies (InterVISTAS-ga<sup>2</sup> Consulting, Inc., 2006; Grosso, 2008; Piermartini & Rousova, 2008; Piermartini & Rousova, 2009; Rousova, 2009; InterVISTAS-EU Consulting, Inc., 2009; Grosso, 2010) to examine the relationship between dependent and independent variables for cross-sections could not be applied in this study due to the unique characteristics of the panel data.

#### **6.6.4 The gravity model and its use in studying air services regulation**

The gravity model was inspired by Newton's "Law of Universal Gravitation" which states that the force attracting two objects depends on their size and on the distance between them (Achard, 2009:28). In the international trade gravity model in its basic form, the amount of trade between two countries or regions is assumed to be directly proportionate to their size and inversely proportionate to the distance between them (Hwang & Shiao, 2011). Linnemann (1966) identified "population" as a measure of country or region size. Gravity-type models have been empirically successful in explaining various interregional and international flows including migration, commuting, international trade and air

passenger services. In transport analysis, models based on intervening opportunities have been as popular as gravity-type models and have been proven to be equally effective. The choice of model over one another reflects the personal preference of the researcher (Taaffe, Gauthier & O’Kelly, 1996). Gravity-type model was selected for the quantitative analysis as it had been proven to be effective in analysing the effects of air services regulation on trade flows in a number of key studies, incorporating air liberalisation indices. Table 6.12 reviews these secondary studies which employed gravity-type models specifically augmented for the degree of regulatory liberalisation of air passenger services as well as the respective explanatory variables utilised in these studies. The dependent variable in these studies is air passenger traffic.

**Table 6.12: Overview of the secondary literature and variables utilised in gravity-type models**

Variable	Myburgh <i>et al.</i> (2006)	InterVISTAS-ga <sup>2</sup> Consulting, Inc. (2006)	Grosche <i>et al.</i> (2007)	Warnock-Smith and Morrell (2008)	Piermartini and Rousova (2008)	Piermartini and Rousova (2009)	InterVISTAS-EU Consulting, Inc. (2009)	Grosso (2008) and (2010)	Empirical model; this study
Read GDP combined				x		x			
LibIndex/ALI/dummy variables for ASA features	x	x		x	x		x	x	x
Terrorism				x					
Distance		x	x		x	x		x	x
Border					x	x		x	x
Colony/historic tie		x			x	x		x	x
Language		x			x	x		x	x
Low income					x				x
ASA age					x	x			x
Trade flows/Flows of services	x	x				x	x		x
GDP per capita (product)/country specific	x	x	x		x		x	x	x
Population	x	x	x						x
Capacity increase	x								
Adverse events	x								
Seasonality	x								
Moment of Inertia		x							
Intervening opportunities		x							
Quality of service		x							
Price		x	x					x	
Catchment area			x						

Variable	Myburgh <i>et al.</i> (2006)	InterVISTAS-ga <sup>2</sup> Consulting, Inc. (2006)	Grosche <i>et al.</i> (2007)	Warnock-Smith and Morrell (2008)	Piermartini and Rousova (2008)	Piermartini and Rousova (2009)	InterVISTAS-EU Consulting, Inc. (2009)	Grosso (2008) and (2010)	Empirical model; this study
Average travel time			x						
Buying power index			x						
Existence of direct services								x	
Reporter island								x	x
Partner island								x	x
Degree of urbanisation		x							

From the above summary, it is evident that there are a number of explanatory variables that may be incorporated into the gravity model to measure air services liberalisation.

As mentioned in Chapter 5, the Delphi generated an extensive list of factors, which according to the experts, have an impact on air passenger traffic flows between a country-pair. These factors were plotted into ten main categories. Several of these factors are particular to the gravity-type model. The factors impacting on air passenger traffic flows that had been statistically measured and quantified in existing secondary research were summarised in table 6.12 above. All of the factors identified by the Delphi and secondary literature, the majority of which were intertwined and interlinked, were assessed in relation to the availability of consistent and reliable data and the ability of the empirical model to statistically quantify and measure these factors over the said period in the African context. Price, for example was not included in the model. This step filtered the independent factors or predictors and narrowed them down to 12 in total.

The empirical model was constructed by combining variables from seven main studies: InterVISTAS-ga<sup>2</sup> Consulting, Inc. (2006); Piermartini and Rousova (2008) and (2009); Rousova (2009); Grosso (2008) and (2010); InterVISTAS-EU Consulting, Inc. (2009) and taking into account the Delphi factors that could be statistically tested by the model. Most of the variables selected for the empirical model had been generated by experts applying the Delphi.

### 6.6.5 The empirical model

The final data set, as discussed, contained 42 cross-sections over the given time period. Table 6.13 lists the variables utilised to compile the panel data set, as well as the corresponding data sources.

**Table 6.13: Description of variables and the data sources utilised**

Variable	Description	Source
<i>Traffic</i>	In the context of other studies on air transport liberalisation, traffic has been defined as the yearly two-way origin-destination traffic between the country-pair. Due to data limitation and its availability over the given time period, the study utilised data from the annual Tourism Report published by Statistics South Africa. The data availability and limitation of the “traffic” variable is discussed in detail in section 6.6.6 below.	Tourism Report (Statistics South Africa, 2001-2011).
<i>GDP</i>	The product of the per capita GDP for the two countries on either side of the route (data are in current US dollars).	World Bank Development Indicators (WDI) database (World Bank, 2011b)
<i>Distance</i>	Distance in kilometres between the most populous cities in the country-pair. The distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important cities or agglomerations (in terms of population).	CEPII (2011)
<i>Border</i>	Denotes whether the two countries in the country-pair share a common border. “1” denotes that they share a common border whereas “0” denotes that the country-pair does not share a common border.	CEPII (2011)
<i>Colony</i>	Denotes whether the two countries in the country-pair share a colonial link. “1” denotes that they do while colonial link and “0” denotes that the country-pair does not share such a link.	CEPII (2011)
<i>Language</i>	Denotes whether the two countries in the country-pair share a common official language. “1” denotes that they do, whereas “0” denotes that the country-pair does not share such a language.	CEPII (2011)
<i>Low_Inc</i>	A dummy variable equal to “1” indicates that one and only one country in the country-pair is a low-income country. This variable was introduced to capture the relatively low attractiveness of low income countries for passengers from other countries (Piermartini & Rousova, 2008).	Grouping of the countries by level of income is in line with the World Bank country classification (World Bank, 2010)
<i>ASA_age</i>	A number of years since the first bilateral was enforced. This variable was incorporated following Piermartini and Rosouva’s (2008) and (2009) approach.	Researcher’s own calculations based on BASAs collected from the DOT.
<i>Trade</i>	This variable refers to services flows. Service activities usually require a close interaction between the seller and	World Bank Development Indicators (WDI) database

Variable	Description	Source
	the consumer, so that the sale of services is an important determinant of the demand for travel (InterVISTAS-EU Consulting, Inc., 2009). It was not possible to obtain data on services trade data for each potential country-pair. Following the approach of InterVISTAS-ga <sup>2</sup> Consulting, Inc. (2006) and InterVISTAS-EU Consulting, Inc. (2009) the model utilises a gravity-type relationship between each nations' services trade with all countries to define a country-pair propensity. The service flows of trade are expressed as: (exports of services by country A x imports of services by country B) + (exports of services by country B x imports of services by country A). Data are in current US dollars.	(World Bank, 2011b)
<i>Partner_island</i>	A dummy variable equal to "1" indicates that a partner country in the country-pair is an island. Partner countries in this study are represented by 45 African countries.	The World Factbook (Central Intelligence Agency, 2011)
<i>Reporter_island</i>	A dummy variable equal to "1" indicates that a reporter country in the country-pair is an island. The reporter country in this study is South Africa	The World Factbook (Central Intelligence Agency, 2011)
<i>ALI</i>	The policy variable is the ALI, which is the cumulative score of the seven features of market access.	Authors' own compilation based on the WTO ALI weighting system (WTO, 2006)

As was discussed earlier, the preliminary empirical equation was formulated taking into account the secondary research on air transport liberalisation and gravity-type models as well as the research objective of the study and included one dependent variable, namely *traffic* and 12 predictor variables.

The main focus of the quantitative research was on the variable *ALI* that denoted the degree of restrictiveness or liberalisation of air services agreements between two countries. Four versions of the ALI were applied to the full panel data set as well as to each of the four regions: 13 states in SADC or 143 observations, seven in East Africa or 77 observations, seven states in West Africa or 77 observations and five states in North Africa or 55 observations. The *region* variable was incorporated into the model to account for the impact of openness on air services agreements between South Africa and the African states in each of the four regions regarding air passenger traffic.

Several time-invariant explanatory variables or predictors, namely *distance*, *border*, *colony*, *language*, *Partner Island* and *Reporter Island*, which had no variation in their

values over the specific period, were omitted from the regression model as they had no power to predict the variation in *traffic*. Previous studies that were able to test the impact of these predictors were all cross-sectional.

Four variables, namely *traffic*, *GDP*, *trade* and *population*, were transformed by a natural logarithmic transformation as the distribution of these variables was highly skewed to the left. Log transformation made the distribution more normal, enhanced the symmetry and stabilised the spread; it also helped the variables to better fit into the model. The transformation helps to reduce heteroscedasticity since it compresses the scale in which the variables are measured. The graphical relationships between the dependent variable and each of the six predictor variables are presented in Appendix K.

Taking the above into account, the final panel data regression model constructed for all four variants of the ALI, namely *STD*, *5<sup>th</sup>*, *DES+* and *OWN+* incorporated one dependent variable, namely *ln(Traffic)* and six predictors, namely *ln(GDP)*, *ln(Population)*, *low income*, *ASA age*, *ln(Trade)* and *ALI*.

For all four variants of the ALI it was established that there were differences between the states in the overall sample of 42 states, compared to the reference country Zambia, which was selected by default as the last country on the list sorted alphabetically in ascending order. Country differences in each of the four regions were also reported. The focus of the panel regression was to determine which of the predictors had an impact on the air passenger traffic variable, *ln(Traffic)*, for the overall South African – intra-African market and whether there were any commonalities or differences across the regions. The purpose of the selected methodology was not the prediction of *ln(Traffic)*, but rather the determination of the predictors that were statistically significant in explaining their impact on the dependent variable, *ln(Traffic)*.

In the model, the significant predictors for the overall intra-African market for all four variants of the ALI weighting system were found to be: *ln(Trade)*, *ALI* and *ln(GDP)*. Of interest are the regional results which were found to be different from the overall results



and the results between each state. The commonalities and the differences of the results are reported and interpreted in the next chapter.

### 6.6.6 Data availability and limitations: traffic variable

As mentioned earlier, the majority of the studies on air services liberalisation were cross-sectional with 2005 as the year of the analysis (InterVISTAS-ga<sup>2</sup> Consulting, Inc., 2006; Piermartini & Rousova, 2008 and 2009; Rousova, 2009; InterVISTAS-EU Consulting, Inc., 2009; Grosso, 2008 and 2010). The data on annual air passenger traffic were provided by the IATA. In Myburgh *et al.* (2006) air passenger panel data from 1998 to 2004 were obtained from the Airports Company of South Africa; however, for reasons of confidentiality, data were only provided for routes flown by more than one airline. This study required two-way origin-destination air passenger traffic data over the said period. The researcher therefore liaised with numerous organisations in pursuit of the data. Table 6.14 summarises the organisations that were approached and the outcome.

**Table 6.14: Traffic data collection**

Organisation	Outcome
ACSA	Unwilling to provide the country-pair historical data due to reasons of confidentiality.
ICAO	Their data covered the period up to 2009 with numerous missing years for many of the African states. Data for 13 states (29% of the sample) were missing for the entire period (2000 to 2009): Algeria, Burkina Faso, Central African Republic, Comoros, Ethiopia, Gambia, Liberia, Mali, Morocco, Niger, Somalia, Sudan and Togo. Due to the size of the sample limited by the actual number of states, the number of observations had to be as complete as possible. Therefore, this data was useless for the research.
Travelport	Advised to contact ACSA, IATA or MIDT as their data only went back 24 months.
IATA Paxis Portfolio	The data were only available from 2005, for a very unaffordable price (ZAR 110000).
UNWTO	Advised to contact ICAO as they were not able to assist the researcher with the data for the selected period.
WTTC	Advised to contact IATA.
MIDT	The data were only available from 2005 to 2010 and at a fee.
Statistics South Africa	The tourism report was the only report available on an annual basis for the entire period from 2000 to 2010.  "Data description: administrative data sources from the DHA, that is, information from all the country's ports of entry and applications for permanent residence constitute the only comprehensive source of information on foreign tourists and

Organisation	Outcome
	<p>departures, documented immigrants and emigrants. The information from this source of data provides the best national coverage (in terms of both space and time) of the population movements of South African residents and foreign travellers. Data routinely collected by immigration officers at all land, air and sea entry ports on all travellers (South African residents and foreign travellers) arriving into or departing from South Africa are captured into the DHA's population Movement Control System (MCS). Generally the data are collected directly from travel documents either by scanning or capturing onto the port's electronic database. Individual ports regularly transmit data into the national database at the head office of the DHA. Statistics South Africa (Stats SA) downloads the data covering a particular calendar month from the mainframe of the State Information Technology Agency (SITA), where the DHA stores its data" (Statistics South Africa, 2011).</p> <p>The Tourism Report provides consistent data on the number of tourists by country of residence and the mode of arrival; hence the researcher was able to use the data to see how many tourists from each of the respective African states arrived in South Africa by air for each of the years.</p> <p>The biggest limitation of this data source was that the information on the total number of arrivals and departures of South African residents is collected through the scanning of their passports. Thus, data on country of final destination and purpose of visit are not available. For example, in 2010 there were 3 404 tourists from Algeria who arrived in South Africa by air. No data is available on how many South Africans flew to Algeria in 2010.</p> <p>Hence the air passenger traffic in this study is limited to the number of foreign tourists arriving by air. This data source was chosen due to its methodological consistency and the fact that the focus of the study fell on the relationship between air passenger traffic and aviation policy. Taking into account the data availability and limitation issues, this was the best source to represent a trend over the selected time period.</p>
<p>Statistical departments of the selected African countries</p>	<p>The statistical departments of the 45 states were researched online but there was no data available on the air passenger traffic over the given time period. The exercise proved that accurate statistics on air passengers between country-pairs in Africa are practically non-existent as such countries' statistical capacity is limited due to lack of training or of funding for adequate staff. Schlumberger (2010) confirms that on several missions to Africa between 2002 and 2008 the data on actual passenger counts were often maintained on paper ledgers with no computerisation. In many cases these data were never submitted to the relevant authorities such as ICAO, leaving exceptionally large holes in the time-series. Many states also believe that they only need to report data on international traffic and that data on intra-African traffic is not a top priority.</p>

## 6.7 HYPOTHESES

### 6.7.1 The null and the alternative hypotheses in this study

In classical tests of significance two kinds of hypotheses are employed: the null and the alternative hypothesis. Researchers test to establish whether there has been no change in the population of interest, in which case they do not reject the null hypothesis; or, whether a real difference exists, in which case they reject the null hypothesis. In the first chapter the hypotheses were formulated thus:

#### Null hypothesis

$H_0$ : There is no relationship between South African aviation policy in Africa and the South African – intra-African air passenger traffic flows.

#### Alternative hypothesis

$H_1$ : There is a relationship between South African aviation policy in Africa and the South African – intra-African air passenger traffic flows.

The same two hypotheses were formulated for each of the four regions, namely the SADC, East, West and North African regions.

The discussion of the previous chapters and this chapter led to a further refinement of the hypotheses and resulted in the following null and alternative hypotheses:

#### 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<sub>1</sub>**: There is a 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.

The same two hypotheses will be tested for each of the four regions, namely the SADC, East, West and North African regions. The main difference of the hypotheses employed in this study, as opposed to those tested in the secondary literature, and discussed in section 6.6.4 above, is that a relationship between the dependent variable and the six predictors was tested simultaneously and not by focusing on the individual impact of each of the predictors in isolation. It is noteworthy that although the objective of the study was to statistically test the impact of the South African aviation policy in Africa on air passenger traffic flows, one cannot test this relationship in isolation as many other variables impact this relationship such as the GDP, population size and so forth. In this study, the principal of partial correlation was therefore applied.

#### **6.7.2 Hypotheses' assumptions**

##### **ALI**

It is expected that the degree of air services liberalisation as measured by the *ALI* will have a positive partial impact on air passenger traffic flows, while all other variables remain constant, both in the full sample of 42 country-pairs as well as in each of the four regions. Liberalised air services agreements improve market access, thereby introducing more competition in the sector and allowing for a better rationalisation of the air services, which in turn will yield lower air fares and/or a better quality of air services (Piermartini & Rousova, 2008). Consumers represented by air passenger traffic flows are expected to respond to these changes by flying more often. This expectation is based on the

InterVISTAS-ga<sup>2</sup> Consulting, Inc. (2006:11) causal chain that links changes in air services regulation to changes in the broader economy as presented in figure 6.7.

**Figure 6.7: Causal relationship between air services liberalisation and economic growth**



Source: InterVISTAS-ga<sup>2</sup> Consulting, Inc. (2006)

### **ASA\_age**

This predictor attempts to account for the effective implementation of an agreement and it is expected to have a positive partial effect on air passenger traffic flows, while all other variables in the model remain constant, both in the full sample of 42 country-pairs as well as in each of the four regions.

### **Ln(GDP)**

It is expected that the GDP, which measures the total magnitude of economic activity of a nation, will have a partial positive impact on air passenger traffic flows as the propensity to fly is likely to increase disproportionately increase with the levels of income. Most research concludes that traffic grows faster than the GDP.

### **Low\_Inc**

This predictor was introduced into the model, following the approach of Piermartini and Rousova (2008) to capture the relatively low attractiveness of low-income countries for

passengers from other countries, and it is expected that the presence of a low-income country will have a partial negative impact on air traffic passenger flows between the country-pair, while all other variables in the model remain constant.

### **Ln(Trade)**

Air passenger traffic flows are expected to be partially positively impacted by the magnitude of air services trade as services trade relations increase the need for face-to-face communication.

### **Ln(Population)**

Air passenger traffic flows are expected to be partially positively impacted by the size of the population. This expectation is based on the results of secondary research (Myburgh *et al.*, 2006; Grosche *et al.*, 2007; Hwang & Shiao, 2011).

## **6.8 CHAPTER SUMMARY**

In this chapter the methodology utilised for the quantitative research, in particular the one-way fixed panel regression was discussed. The use and application of the ALI, developed by the WTO Secretariat, were explained in the context of the South African aviation policy in Africa. This was represented by a panel data set covering an 11 time period. The distribution of the ALI total scores confirmed varying degrees of liberalisation between South Africa and its 45 bilateral air counterparts. Based on the assessment of the ALI scores, it can be concluded that gradual liberalisation has taken place over the given period, with unique progress dynamics prevailing in the overall market and each of the four regions.

Furthermore, the empirical panel regression model and the variables selected, accounting for the respective data availability and limitations, were comprehensively reviewed. The

next chapter discusses the results of the fixed one-way panel regression in each of the five markets, linked to the hypotheses formulated in this chapter.