Liberalization of Air Transport Services and Passenger Traffic

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Abstract

Using a gravity type model to explain bilateral passenger traffic, this paper estimates the impact of liberalizing air transport services on air passenger flows for a sample of 184 countries. We compare two measures of the overall bilateral degree of air transport liberalization: a newly constructed index of bilateral air transport liberalization involving the judgment of experts as to the importance of each type of regulation and a statistical index we built using factor analysis. Then, we turn to the analysis of the impact on passenger flows of each specific regulation and of each type of agreement, whereby types of agreement are identified using cluster analysis of the existing air service agreements.

We find robust evidence of a positive and significant relationship between the volumes of traffic and the degree of liberalization of the aviation market. In particular, the result is driven by the impact of air service liberalization for country-pairs with existing direct services. Using the most conservative estimates, an increase in the degree of liberalization from the 25th percentile to the 75th percentile increases traffic volumes for these country-pairs by approximately 18 per cent. Furthermore, the relaxation of restrictions on designation of airlines, pricing and capacity turns out to be the most important liberalization factors, corresponding jointly to an increase in traffic volumes by approximately 50 per cent. These results are robust to the inclusion of country fixed effects and the use of different estimation techniques (Tobit and Poisson estimation methods). The model explains approximately 80 per cent of the variation of air passengers' traffic.

Keywords: bilateral air service agreements, air transport, liberalization, gravity model, passenger traffic

JEL Classification: F15, L93

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1. Introduction

Air transport has rapidly expanded in the last few decades. Passenger traffic experienced an average annual increase of about nine per cent between 1960 and 2000 and five per cent between 2000 and 2005 (Hanlon, 2006 and WTO, 2007). Cargo shipped by air (measured in ton-miles) increased in the period 1997-2004 at an annual growth rate of over 10 per cent. Recent estimates show that air cargo accounts for over one third of the value of world merchandise trade (Hubner and Sauve, 2001). In particular, for the United States, air transport covers a third of its import value and half of United States' exports outside North America (Hummels, 2007a).

The reason for this rapid expansion was the decline of air transport costs. Measured in terms of revenue per ton-kilometre, air transport costs dropped by 92 per cent between 1955 and 2004 (Hummels, 2007). The diffusion of jet engines was the principle factor of this reduction over the period 1955–72, the period when the use of jet engines became widespread. More recently, changes in the regulatory set-up also helped to reduce air transport costs. For example, Micco and Serebrisky (2006) show that between 1990 and 2003 the introduction of the Open Skies Agreements (OSAs) in the US has reduced nominal air cargo transport costs by nine per cent and has increased by seven per cent the share of imports arriving by air within three years after an OSA was signed.

International air transport in general and international passenger transport in particular play a crucial role in the process of international integration and also affect the development of other sectors of an economy. By reducing the time required to reach a distant location, air transport is an important determinant of overall transport costs, especially for trade[2] and travel to distant locations. It is for this reason that air transport is the commonly used means of transport for passengers to reach distant destinations.

Therefore, air passenger transport is essential to the development of the international tourism sector, especially in remote locations. By the same token, air passenger transport is essential to set up and maintain business relationships between distant economies. A number of recent studies have highlighted the importance of movement of people for trade (e.g. Rauch and Trindade, 2002; Herander and Saavedra, 2005 and Jansen and Piermartini, 2008). People travel to the country they import from in order to establish trade relationships, for example, because they need to find an appropriate supplier. Higher passenger flows between two countries also lower information and enforcement costs, thus fostering trade. In addition, rules and regulation governing passenger traffic are also important for air cargo. In fact, 50 per cent of overall amount of cargo is transported on passenger flights rather than dedicated cargo flights, using the otherwise empty belly space or "combi operations" (OECD, 2000).

The aim of this paper is to study the impact that air service liberalization has on the aviation industry and to identify which specific provision or which type of air service agreement provide most of the benefits from increased competition. The research is motivated by the observation that the international aviation market is heavily regulated by an intricate web of bilateral air services agreements (ASAs)[3], that establish the conditions under which air companies operate on each bilateral route. These rules define, for instance, whether airlines can freely set prices, how many airlines can operate on a specific route, and the capacity of flights. Clearly, the degree of liberalization of air transport services between two countries is determined by the specific design of each ASA. Although air service industry has been recently liberalized, through a number of bilateral and regional agreements, substantial restrictions remain. ASAs may not effectively promote competition if a specific restriction stays in the regulatory regime. There is, however, scarce empirical evidence on the impact of liberalization of international air transport service on the industry. Existing research is

[2] Using gravity models, recent studies find that a 10 per cent decrease in time to export increases trade by between 5 and 25 per cent depending on the sector and export destination (see for example Hausman et al.,2005), Djankov et al., 2006, Nordas, 2007a, 2007b and Nordas et al. 2006).

[3] Air transport services are excluded from GATS, the WTO multilateral agreement on trade in services.

either limited to a few countries or suffer from important methodological shortcomings. This includes problems of omitted variable bias, collinearity and lack of robustness in the results.

The analysis in this paper focuses on the impact of air service agreements on passenger flow. One reason is that the use of passenger flows as a proxy for the economic performance of the air service sector allows us to work with an extensive database. No worldwide information on the bilateral trade in goods by means of transport exists and the complete database on airfare is extremely expensive. Another reason is that airfares are very volatile, and existing studies based on this variable report a very low fit of the data.

In order to explain air passenger flow, we build on a gravity-type model augmented for the degree of liberalization of air passenger services. This model includes the standard explanatory variables used in gravity models of trade such as distance as well as several variables specific to the aviation market. In particular, the number of years that each ASA is in force and the existence of a direct service are introduced. The underling idea is that the extent of liberalization is likely to influence the price and the quality of the service offered on a specific route, thus determining the bilateral distribution of passenger traffic. We therefore expect a positive effect of air service liberalization on passenger traffic.

Our contribution to the literature is threefold. First, this is the first paper that assesses the impact of air service trade liberalization for a worldwide sample of countries (184 countries) using indexes of air service liberalization. While existing literature covers at most 35 countries or a specific region, our analysis covers approximately 2300 country-pairs involving 184 countries.

Second, we estimate the impact of the degree of liberalization of bilateral and regional air service agreements (ASAs) on air passengers' traffic by looking at alternative indexes of the overall degree of liberalization. Existing empirical studies (Gonenc and Nicoletti, 2000 and Doove et al., 2001) measured the degree of liberalization by means of an index built using factor analysis. This is a purely statistical technique and assigns the highest weights to the provisions that vary most independently in the database. Recently, the WTO Secretariat (WTO, 2006) has developed an informed index of the degree of liberalization of air services for passenger traffic, whereby different provisions are weighted on the basis of the importance in removing obstacles to trade in air services according to the judgment of experts of the sector. In this paper we use and compare the results of both approaches, factor analysis and expert-based approach, to measure the degree of air service liberalization.

Finally, we analyze how passenger flow is influenced by specific regulations and by types of agreement, whereby types of agreement are identified using cluster analysis of the existing air service agreements.

The rest of the paper is organised as follows: section 2 reviews the literature describing what measures of air-service barriers to trade have been used as well as the type of analysis that has been performed and the results of this analysis; section 3 introduces the data on worldwide passenger flow and the alternative measures of extent of liberalization of the aviation market. It compares the informed index produced by the WTO Secretariat with the statistical index resulting from factor analysis; section 4 explains the methodological approach; section 5 describes the results; and finally section 6 concludes.

2. Review of the literature

Very few studies analyse the impact of air service liberalization on the economic performance of the sector and on trade. In general, these studies focus on the impact of air service regulation on airfares, passenger flows or on the share of trade occurring via air. Overall, they tend to find a negative impact

of restrictiveness of regulation on the economic performance of the industry (higher fares or less trade). They, however, also present important limitations in the terms of coverage and methodology.

A general shortcoming of the existing literature is that the analysis is conducted on the basis of a small number of countries and routes. For example, Gonenc and Nicoletti (2000) examined the effects of bilateral air service agreements on prices of air passenger transport in thirteen OECD countries. The study was then extended to a number of 35 countries by Doove et al. (2001). However, this study includes only 11 non-OECD countries. Using the index of air service restrictiveness built by Gonenc and Nicoletti, on the basis of principle component analysis, Doove et al. estimated positive and significant effects of restrictiveness on airfares. The estimated impact (calculated on 1998 airfares data) ranges between 3 and 22 per cent, with larger effects for developing countries than for developed countries. However, the goodness of fit of the estimated equation is very low (the adjusted R-square ranges between 0.2 and 0.4), thus implying that some important variable may be omitted from the regression and that the results may be biased.

A study by Micco and Serebrisky (2004) investigates the impact of US OSAs on airfares and on the share of US imports arriving by air. In this paper, the authors study the impact of OSAs by introducing dummies for the existence of OSAs in the equation of the determinants of airfares and of the share of imports arriving by air. Using this approach, they estimate that for developed and upper-middle income countries signing OSAs on average reduced air fares by 9 per cent and increased the share of imports arriving by air by 7 per cent three years after the OSA is signed. The results are not significant when middle and low income countries are kept in the sample. One possible reason is that Micco and Serebrisky's analysis does not allow to distinguish the degree of liberalisation introduced by an OSA and the initial level of restrictiveness of air services trade.

The coverage for the analysis of the impact of air service liberalization is expanded to 1400 country-pairs worldwide in a recent study conducted by InterVISTAS-ga (2006). This study assesses the impact of air traffic liberalisation on trade and other economic measures, including passenger traffic, using two approaches: case studies on bilateral and regional liberalisation and a gravity-type model. The results suggest that air service liberalization increased trade, economic development and passenger traffic. However, InterVISTAS-ga's analysis presents two major methodological shortcomings. First, the gravity-type model for passenger traffic does not include distance among the regressors. Distance is a standard variable in gravity models and a major determinant of transport costs. Because of this omission, the study is most likely to suffer from omitted variable bias. Second, the study only looks at the impact of specific ASAs provisions separately. This is done by introducing in the regressions dummy variables denoting whether the agreement provides the right for stop-over (the so called fifth freedom), price controls, capacity constraints and designation requirements (that is a limit in the number of air companies that can provide a service). Because of collinearity among these dummy variables, the impact of these policies can only be partially assessed and the analysis does not allow the capturing of the overall level of liberalization of each ASA.

Focussing on intra-APEC passenger flow, a recent study (Grosso, 2008)[4] uses a gravity model approach to estimate the impact of intra-APEC air service liberalization on the intra-regional passenger traffic. The study uses the informed index built by the WTO Secretariat (2006) as a measure of the degree of liberalization, but it does not find robustly significant results. In particular, the study doesn't find a significant effect of air service liberalization on regional passenger flow when fixed effects are included in the regression. The theoretical specification of the gravity equation requires that fixed effects are included in the regression to obtain unbiased results (Anderson and van Wincoop, 2004).

To our knowledge, our is the first paper that assesses the impact of air service trade liberalization for a worldwide sample of countries (184 countries) using indexes of air service liberalization. In addition, this is the first paper that is able to compare a statistical and an informed index of service trade

[4] This is an on-going study that has been conducted at the same time as our research.

restrictiveness and to provide an understanding of the most effective liberalizing specific policy measures or policy combinations.

3. Air passengers' traffic flows and liberalization of the aviation market

This section is divided in two subsections. The first subsection describes the distribution of international air passenger traffic across countries worldwide and on the routes covered by international air services agreements. The target is to provide an understanding of the extent of the coverage of the database we use for the empirical analysis.

The second subsection looks at the degree of liberalization of the aviation market. It, first, describes the key features of an air service agreement and provides some statistics on the relative prevalence of different features across agreements. Then, it illustrates and compares two measures of the degree of liberalization. One is the informed index of liberalization built by the WTO Secretariat (WTO, 2006) on the basis of consultations with experts. The second one is the statistical index of liberalization we built using principal component analysis on the basis of the raw data of the agreements.

(a) International air passenger traffic

There were in total 688 million international air passengers worldwide in 2005 according to the IATA statistics for country-pair scheduled passenger traffic. As shown in Table 1, over 80 per cent of these travelled between two high income countries or between a high income country and a middle income country.[5] The share of international air passenger traffic among low income countries is a mere one per cent of the worldwide scheduled traffic. Although based only on scheduled flights, this is likely to be a good approximation of overall trends in passenger traffic, as scheduled traffic accounts for 85 per cent of total passenger traffic, that is including also charter flights (Gonenc and Nicoletti, 2000). Hereafter we will refer to scheduled passenger traffic only.

Table 1 also shows patterns of passenger traffic between those country-pairs for which we have information on air service agreements in force in 2005 (Hereafter we refer to these agreements as coded ASAs). This is a sample of 2299 country-pairs covering 184 countries and approximately 80 per cent of worldwide international scheduled passenger traffic (545 million passengers out of a total 688 million passengers worldwide). The figures reported in Table 1 show that this sample of country-pairs provides a good representation of the distribution of passenger flow by income group, although there appears to be a certain over-representation of passenger traffic among high income countries. In the sample of country-pairs for which a coded ASA exists, it refers to 61 per cent of traffic, while it represents only 51 per cent of traffic worldwide.

Table 1: International air passengers, 2005 (percentages)

	Total traffic			**Traffic covered by coded ASAs**		
Income Group	Low	Middle	High	Low	Middle	High
Low	1.0	2.1	5.2	0.7	1.4	3.4
Middle		5.4	30.8		3.9	29.4
High			51.2			61.2
Total (millions)		**688.2**			**544.9**	

Note: Low, middle and high income countries correspond to the World Bank definition. The sum of the percentages lies below 100 per cent, because of missing data on income for a few countries.
Source: Authors' calculations based on IATA country-pair scheduled passenger traffic data.

[5] The IATA database refers to true-origin and true-destination. That is, it does not include flows of passengers from a country where they only stopped over before getting to their destination country.

The total number of air service agreements in force is unknown. This is mainly due to the fact that there may be potentially a very large number of agreements for countries, between which there is no direct service link[6]. For instance, 57 of the 72 ASAs concluded by Zambia are not coded and there is no direct service operating on the corresponding routes (Mattoo and Payton, 2007). However, relying on the assumption that for the country-pairs where there is a direct air service link an agreement must exist, it is possible to get an understanding of the relevance of existing information on the agreements in the two cases: when there is a direct service and when there is not.

As shown in Table 2, the majority of coded air service agreements refer to country-pairs where a direct service exists (1302 out of 2299). However, the ICAO's WASA database (ICAO, 2005) and the QUASAR database (WTO, 2006 and 2007) cover also air service agreements across countries that are not connected by a direct air service. These represent 997 country-pairs. In addition, just above half of the air service agreements related to country-pairs where a direct service is provided are coded. However, in terms of passenger traffic, the sample of country-pairs with coded ASA information and with a direct service represents 77 per cent of worldwide international air passenger traffic and over 85 per cent of passenger traffic between countries covered by a direct service link. The coverage in terms of passenger traffic of country-pairs not connected by a direct service and for which coded ASA information exists appears much lower in two respects. First, these country-pairs represent only 2 per cent of worldwide passenger traffic. Second, ASA coded country-pairs without a direct service represent only a small share (less than 25 per cent) of the passenger traffic via non-direct routes.

Table 2: Number of country-pairs (percentage of worldwide air passenger traffic for these country-pairs) and availability of information on air service agreements

	ASA exists		ASA does not exist	Total
	Coded	Non-coded		
Direct service	1302 (77)	approx. 1100 (12)	0 (presumably not possible)	approx. 2400 (89)
No direct service	997 (2)	unknown (9)	unknown	approx. 18700 (11)
Total	2299 (79)	unknown (21)	unknown	21115 (100)

Source: Authors' calculations based on WASA database (ICAO, 2005), QUASAR database (WTO, 2006 and 2007) and IATA country-pair scheduled passenger traffic data.

To sum up, the country-pairs for which coded information on the ASA exists provide a good coverage of overall worldwide passenger traffic, especially for passengers travelling between countries where a direct service exists. For this reason and because we expect ASA to have a different impact for country-pairs where there is a direct service and where there is not, we also investigate the two cases separately in the empirical analysis.

(b) The degree of liberalization of the aviation market

Measuring the degree of ASAs liberalization is a complex task. In general, very detailed measures of liberalization of air services markets are likely to lead to multicollinearity problems in the regressions. That is, they provide incorrectly insignificant results, due to the high degree of correlation among various indicators of openness. On the other hand, aggregated measures delivers only limited information about the important features in the liberalization process. In addition, the aggregation is to a large extent arbitrary, since a number (or a vector of numbers) has to be associated with each agreement according to some rule, but there are infinitely many ways to define such a rule.

In this section, we adopt three different approaches for measuring liberalization: 1) we propose a series of 0-1 dummy variables each one capturing a specific feature of an ASA; 2) we use an informed

[6] A direct service is "a service operated under the same flight number". It can therefore comprise non-stop services as well as 5th freedom and 7th freedom services as long as the flight number remains the same.

index of ASA's degree of liberalization; 3) we build a statistical index of air service liberalization on the basis of factor component analysis. In addition, we point out that relatively few types of agreements exist and they can be easily ranked from the most restrictive to the most liberal.

(i) Key features of air service agreements

ASAs incorporate many features covering a wide range of topics such as aviation security, incident investigation, immigration, control of travel documents and many others. In a recent study, the WTO Secretariat (WTO, 2006) has identified seven features of ASAs as relevant indicators of openness for scheduled air passenger services. These include[7]:

a) **Grant of rights**, that defines the rights to provide air services between the two countries. In particular, the WTO study focuses on the fifth freedom, seventh freedom and cabotage. *Fifth freedom* is the freedom to carry freight/passengers between two countries by an airline of a third country on a route with origin or destination in its home country. *Seventh freedom* allows carrying freight/passengers between two countries by an airline of a third country on a route with no connection with its home country. *Cabotage* is the freedom to carry freight/passengers within a country by an airline of another country on a route with origin/destination in its home country;
b) **Capacity clause,** that identifies the regime to determine the capacity of an agreed service. The capacity regime refers to the volume of traffic, frequency of service and/or aircraft type(s). Sorted from the most restrictive to the most liberal regime, three commonly used capacity clauses are predetermination, Bermuda I and free determination. *Predetermination* requires that capacity is agreed prior to the service commencement; *Bermuda I* regime gives limited right to the airlines to set their capacities without a prior governmental approval and *free determination* finally leaves the capacity determination out of regulatory control;
c) **Tariff approval** that refers to the regime to price air services. The most restrictive regime is that of *dual approval*, whereby both parties have to approve the tariff before this can be applied. The most liberal regime is *free pricing*, when prices are not subject to the approval by any party. The semi-liberal regimes are *country of origin disapproval* (tariffs may be disapproved only by the country of origin), *dual disapproval* (both countries has to disapprove the tariffs in order to make them ineffective) and *zone pricing* (the type of control depends on given reference points);
d) **Withholding** that defines the conditions required for the designated airline to operate on a specific route. Restrictive conditions require *substantial ownership and effective control*, meaning that the designated airline is the "flag carrier" of the country. More liberal regimes are *community of interests* and *principal place of business* regimes, when a foreign airline can be also designated. Community of interests regime still requires a vested substantial ownership and effective control of the airline in one or more countries that are defined in the agreement, but principal place of business regime removes the substantial ownership requirement and is thus more liberal
e) **Designation** that governs the right to designate one (*single designation*) or more than one (*multiple designation*) airline to operate on a route;
f) **Statistics** that provides rules on exchange of statistics between countries or their airlines. If exchange of statistics is (can be) requested, it is an indicator that the parties intend to monitor the performance of each other's airline and is thus viewed as a restrictive feature of an agreement.
g) **Cooperative arrangements** that define the right for the designated airlines to enter into cooperative marketing agreements. This right provides a number of commercial advantages and is thus considered as a liberal feature of an agreement.

[7] More detailed description of the indicators of openness is provided in the Appendix (Table A1) and in WTO (2006), App. 1, page II. 650.

Table 3 shows the number of agreements where a specific provision appears. It is interesting to notice that the most restrictive regime is usually the most frequent. For instance, dual approval of air tariffs is required in more than 70 per cent of ASAs. Similarly predetermination, substantial ownership and effective control and the request for exchange of statistics are included in most of the agreements. Cooperative arrangements are mostly not allowed as well. 5th freedom right is included quite often, while 7th freedom and cabotage are very rare. Different pattern arises only for the designation of airlines, since multiple designation is allowed in more than 60 per cent of agreements.

Table 3: Frequencies of regimes/provisions of ASAs

Regime	Frequency	Regime	Frequency
Grant of righs		**Withholding/Ownership**	
5th freedom	1650	Substantial ownership and effective control	1735
7th freedom	417	Community of interest	396
Cabotage	353	Principal place of business	138
Missing values	0	Missing values	59
Pricing regimes		**Capacity regimes**	
Dual approval	1625	Predetermination	1324
Country of origin disapproval	37	„Other liberal“	125
Dual disapproval	153	Bermuda I	327
Zone pricing	8	„Other restrictive“	10
Free pricing	381	Free determination	464
Missing values	94	Missing values	49
Total	**2299**		**2299**
Designation		**Statistical exchange**	
Single	879	Exchange of statistics required	1492
Multiple	1411	Exchange of statistics not required	807
Missing values	9	Missing values	0
Total	**2299**		**2299**
Cooperative arrangements			
Not allowed	2173		
Allowed	126		
Missing values	0		
Total	**2999**		

Note: The frequencies of freedom5, freedom7 and cabotage do not sum up to 2299 observations, because they are independent provisions, not excluding each other. Similarly, some ASAs report combination of ownership regimes.
Source: Own calculations based on WASA database (ICAO, 2005) and QUASAR database (WTO, 2006 and 2007).

(ii) Two Indexes of air service liberalization

Indexes can be built to provide an indication of the overall degree of liberalization introduced by a certain air service agreement. The construction of an index involves the choice of weights to assign to each provision to denote its marginal contribution to liberalization of the aviation market. However, the choice of the weights is arbitrary and infinitely many options exist. In this section we illustrate two alternative approaches: one based on an expertise-knowledge and another one based on the use of factor analysis.

An informed index of air service liberalization: the ALI

The Air Liberalization Index (ALI) constructed by the WTO Secretariat (WTO, 2006), is an expert-based index. The weights assigned to the different provisions of air agreements were defined in consultation with a group of experts on aviation industry with the view to capture the relative importance of each provision in liberalizing the sector. The ALI ranges between 0 and 50, where 0 is associated with the most restrictive agreement and 50 denotes the most liberal agreement.

Four different weighting schemes were proposed, thus originating four different indexes. The weighting scheme of the so called standard ALI (*ali_standard* in Table 4) assigns a weight between 0 and 8 to each of the seven components of ASAs. Each of the three other indexes emphasises one specific feature of ASAs, namely the granting of fifth freedom traffic rights, withholding and designation clause. In particular, the *ali_5thfreedom* assigns a weight of 12 to the 5th freedom. The *ali_ownership* assigns a weight of 14 to the provision that allows foreign airlines to service a route if their principal place of business and effective control is in the foreign country. The *ali_designation* assign a weight two times larger than in the standard ALI to multiple designation.[8] The reason for introducing these alternative indexes is to account for specific geographical and economic factors that may in some circumstances render these provisions more relevant to improve market access.

As shown in Table 4, the four ALI indexes are highly correlated among themselves, with correlation coefficients and the Spearman rank correlations around 90 per cent or above.

Table 4: Correlations between the different versions of ALI

	ali_standard	***ali_5thfreedom***	***ali_ownership***	***ali_designation***
ali_standard	1			
ali_5thfreedom	0.98 (0.95)	1		
ali_ownership	0.99 (0.99)	0.96 (0.92)	1	
ali_designation	0.99 (0.96)	0.97 (0.89)	0.99 (0.95)	1

Note: Spearman rank correlations reported in parenthesis.
Source: Authors' calculations based on WASA database (ICAO, 2005) and QUASAR database (WTO, 2006 and 2007).

A Statistical Index: the *FA_index*

Following the approach of previous empirical literature on air transport services (see Gonenc and Nicoletti, 2000), we construct an index of air service liberalization by means of factor analysis technique as introduced in Nicoletti et al. (1999) (hereafter we will refer to this index as the *FA_index*).[9] The *FA_index* ranges than between 0 and 1 and is increasing in the degree of market liberalization[10].

Factor analysis involves several steps. First, we need to define the database. There are over 100 provisions in ASAs and most of them do not relate to market access. Following the approach of previous literature and relying on the WTO study on air services agreements (WTO, 2006), we apply factor analysis to the seven components of the regulatory framework highlighted in the WTO study as relevant to market access. In particular, we apply factor analysis to the database obtained by using the weights given in the ALI standard as a priori weights for the single components of ASAs. In addition, each component is normalized to take values between 0 and 1 (see Table A1 and A2). The bilateral restrictiveness (BRI) used in Gonenc and Nicoletti (2000) and Doove et al. (2001) is based only on

[8] The complete set of weights is provided in Appendix Table A2.

[9] Factor analysis is a statistical tool that allows to summaries detailed information about regulations in an index where weights are assigned to each component of the regulatory framework on the basis of their contribution to the overall variance in the data.

[10] Note that an index of restrictiveness could easily be obtained, for instance, by taking 1- FA_index.

four regulatory indicators, namely designation, capacity limitations, pricing regimes and authorisation of charter flights on the route.

The second step of factor analysis consists of extraction of the factors. That is, in this step we identify the number of latent factors needed to represent the database. The result of this extraction is a set of coefficients, called loadings, that show the correlation between each component of the ASA and the latent factor. There is a set of loadings for each factor extracted. The first factor accounts for most of the variance in the data. Subsequent factors account for a smaller and smaller portion of the variance. We adopt the following rule of thumb to select the relevant factors: i) each factor is associated with eigenvalues larger than one; ii) each factor contribute to explain more than 10 per cent of the overall variance of the data; and iii) cumulatively factors contribute to explain more than 60 per cent of the total variance of the data.[11] This step yields us two factors.

The third step consists in the "rotation" of these factors. This transformation is targeted to reduce the number of significant components (those with a loading larger than 0.5) in each factor, in order to allow for an interpretation of the factors. We do not however get a significant reduction in the number of significant components in Factor 1 after rotation.

The results of factor analysis are presented in Table 5. The first two factors together explain 68 per cent of the overall data variation. Factor 1 accounts individually for more than 50 per cent of data variability. The magnitude of its loadings (in general larger than 0.5) indicates that Factor 1 is highly correlated with all indicators of air service liberalization, but cooperative arrangements (*coop*). Factor 1 is therefore to be interpreted as an indicator for overall liberal agreements. The detection of one common factor for most of the indicators of liberalization is due to the strong correlation between them (in the range of 30 and 82 per cent). Factor 2 explains only 16 per cent of the data variability. Its main contribution to the overall variance is as an indicator for cooperative arrangements (*coop*).

Table 5: Construction of FA_index by Factor Analysis

	Factor 1: overall liberal		**Factor 2: *coop***		***FA_Index***	***ali_standard***
explained variance	52%		16%		68%	
eigenvalues	3.64		1.10			
Components	**loadings**	**weights**	**loadings**	**weights**	**weights**	**relative weights**
freedoms	0.89	0.22	-0.07	0.00	0.17	0.36
capacity	0.89	0.22	0.14	0.02	0.17	0.16
pricing	0.91	0.23	0.13	0.02	0.18	0.16
withholding	0.68	0.13	-0.05	0.00	0.10	0.16
designation	0.50	0.07	0.35	0.11	0.08	0.08
statistics	0.72	0.14	0.14	0.02	0.11	0.02
coop	0.04	0.00	0.96	0.83	0.19	0.06
Weights of factors		0.77		0.23	1	1

Note: Factor loadings were obtained by the principal component method and after varimax rotation. Factor loadings over 0.5 and their relative weights are in bold face.
Source: Authors' calculations based on WASA database (ICAO, 2005) and QUASAR database (WTO 2006 and 2007).

The final step of the factor analysis is the calculation of the weights needed for the construction of the overall index of liberalization, the *FA_index*. The approach we use to calculate weights consists in assigning to each component/factor a weight according to the proportion of the variance that is explained by the component/factor. Formally, this is done as follows: Within each factor the weights for the individual components are calculated as the ratio of the squared factor loading and the sum of all squared factor loadings for that factor. The weights associated to each factor are calculated as the

[11] The same criteria have been followed by Nicoletti et al. (1999).

ration of the sum of all squared factor loadings related to the factor and the sum of the squared factor loadings related to both factors. Finally, the weigh associated to each component in the *FA_index* is a weighted average of the weights of each component in the two factors. Algebraically, these weights are calculated as:

$$\text{weight}_{i,j} = \text{factor loading}_{i,j}^{\,2} \Big/ \left(\sum_{k=1}^{7} \text{factor loading}_{k,j}^{\,2} \right),$$

$$\text{weight}_{j} = \left(\sum_{k=1}^{7} \text{factor loading}_{k,j}^{\,2} \right) \Big/ \left(\sum_{l=1}^{2} \sum_{k=1}^{7} \text{factor loading}_{k,l}^{\,2} \right),$$

$$\text{weight}_{i} = \sum_{j=1}^{2} \text{weight}_{ij} \cdot \text{weight}_{j}$$

where i denotes the component and j the factor.

Weights by individual components are reported in Appendix Table A2.

In order to compare the *FA_index* with the ALI, in the last column of Table 5 we report the relative importance of each component of liberalization in the calculations for the *ali_standard*. Figures show that the in the *ali_standard* the grant of rights and withholding components have a relative higher weight than in the *FA_index*, while the opposite is true for *statistics* and *coop*. However, overall the ALI (in its four versions) and the *FA_index* are highly correlated (correlations coefficients are always over 93 per cent). The Spearman correlation coefficient, based on the countries-pair ranking, is somewhat lower, but still over 84 per cent in all cases. These results are robust to running factor analysis on dummy variables related to 19 individual provisions of ASAs and on alternative sample sizes. Finally, our *FA_index* is broadly consistent with the index of bilateral restrictiveness (the BRI) calculated by Gonenc and Nicoletti (2000). The correlation coefficient between the indexes BRI index and *ali_standard* (*FA_index*) is -0.88 (-0.84). The negative sign is because the ALI and the *FA_index* denote the degree of liberalization while BRI is a measure of restrictiveness of air services.

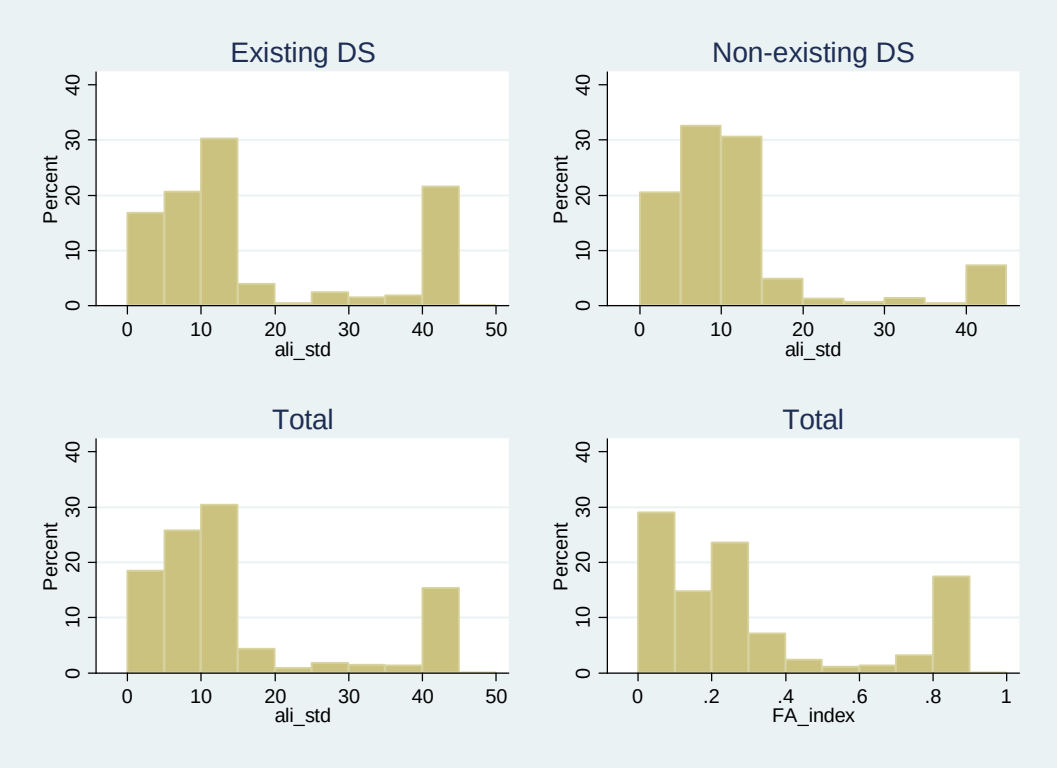
(iii) How deep is air-transport service liberalization

Table 3 above showed that restrictive regimes are very frequent in the design of ASAs. But, we were not able to assess the overall degree of liberalization of ASAs. What is the pattern and the extent of liberalization that emerges from the distribution of the indexes?

Figure 1 displays histograms of *ali_standard* for three samples: that of country-pairs linked by direct air services, that without direct services and the full sample. The last histogram shows the distribution of the *FA_index* for the full sample of country-pairs. The distribution of the degree of liberalization of air service agreement appears to be highly skewed toward the left. Approximately 70 per cent of ASA presents an *ali_standard* (*FA_index*) below 15 (0.4). Very few ASAs introduce an intermediate degree of liberalization (in the 15-40 for the *ali_standard* or 0.4-0.8 for the *FA_index*). A high degree of liberalization of the aviation market (where the *ali_standard* falls in the range 40-45) is reached only in 15 per cent of country-pairs. This is mainly due the liberalization of air services intra EU (for which *ali_standard*=43). The distribution of *ali_standard* is similar for the sample of ASAs between countries where a direct air service exists and where it does not.

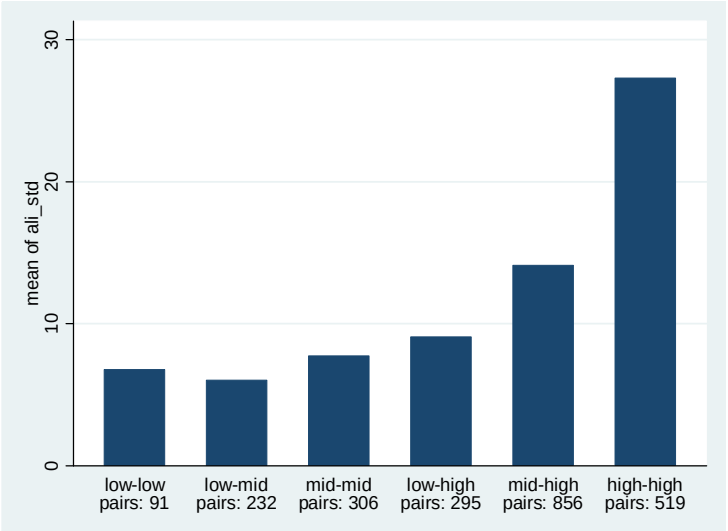
An interesting aspect of the complicated web of regulation set up by the plethora of bilateral air service agreements singed between countries is to what extent they liberalize South-South as well as North-South and North-North air services trade. Figure 2 shows the average level of *ali_standard* among country-pairs sorted by their level of income. The figure shows that ASAs between high-income countries are more liberal than ASAs between low and middle-income countries.

Figure 1: Distribution of the degree of liberalization of the aviation market across ASAs



Note: DS denotes direct service.
Source: Authors' calculations based on WASA database (ICAO, 2005) and QUASAR database (WTO, 2006 and 2007).

Figure 2: The extent of liberalization of aviation market by income levels



Note: Low, middle (mid) and high income countries correspond to the World Bank definition.
Source: Authors' calculations based on WASA database (ICAO, 2005) and QUASAR database (WTO, 2006 and 2007).

To sum up, overall bilateral air service agreements seem to provide a minor contribution to the degree of liberalization of the aviation market. The extent of liberalization appears to be linked to the average level of income of the countries involved in the specific agreement. High degree of liberalization is achieved only among high income countries, while ASAs between low income countries are in general restrictive.

4. The empirical model

In order to assess the impact of air traffic liberalization on international air passenger traffic, we estimate a gravity type model of the bilateral passenger flow between city pairs. The gravity model originally inspired by Newton's gravity law is widely used in social sciences to describe spatial flows. The gravity model is the workhorse model to analyze international trade flows[12], but it is also used to describe migration flows[13] and trip distribution in general. The analogy with the physical law of gravity derives from the fact that the interaction between two locations depend on some elements of mass and distance.

Using data on the overall number of passengers between two countries for a cross section of 2299 country-pairs, covering 184 countries for the year 2005, we estimate a gravity type model augmented for the degree of regulatory liberalization of air passenger services.

The basic empirical specification of the equation we estimate is the following:

$$(1)\ \ln(PassengerTraffic)_{ij} = \alpha + \beta_1 \ln(distance)_{ij} + \beta_2\, border + \beta_3\, colony + \beta_4\, language + \beta_5 \ln(GDPpc_i * GDPpc_j) + \beta_6 \ln(pop_i * pop_j) + \beta_7 \ln(remoteness_i * remoteness_j) + \beta_8\, low\_income_{ij} + \beta_9 \ln(trade)_{ij} + \beta_{10}\, direct\_service_{ij} + \beta_{11}\, air\_liberalization_{ij} + \beta_{12}\, ASA\_age_{ij} + \varepsilon_{ij}$$

where ε_{ij} is the error term, the symbol ln denotes logarithms. *PassengerTraffic* is the total number of passengers traveling on a route. This is calculated as the sum of passenger flying from i to j and from j to i.

The focus of this study is on the *air_liberalization*. We expect that the higher the degree of liberalization of air passengers services the higher is passenger traffic. The reason is that the liberalization of air services provided on a route, by allowing for more competition, is likely to either reduce air fares or to improve the quality of the services offered on that route. As a consequence, this would lead to higher demand for the services and therefore flows of passengers. As a measure for *air_liberalization* we use the measures introduced in section 3.

The other variables in equation (1) are the standard gravity regressors and some control variables specific to air services trade. In particular, the variables *distance*, *border*, *colony* and *language* are the standard gravity model regressors in the empirical trade literature denoting the distance in km between the most populated cities in countries i and j, whether countries i and j share a common border, a colonial link or a common official language, respectively.

Like in a standard gravity equation, we expect that passenger traffic is negatively affected by distance. Distance is a proxy of the cost of travel, including in terms of the time required to reach destination. So it has to be expected that traffic between two countries is lower the further away the countries are from each other. Recent developments on the theoretical foundations of the gravity model for trade have showed that it is not absolute trade costs but relative trade costs that matter to determine the distribution of bilateral trade. In their paper, Anderson and van Wincoop (2003) show that bilateral trade is a function of bilateral trade costs and two multilateral resistance terms. As a measure of bilateral trade in air transport services, passenger traffic will also be determined by relative trade costs. In order to take relative trade costs into account we introduce *remoteness* as a regressor in our empirical model. Following standard practice (see Head, 2003), we measure remoteness as the GDP

[12] Recent literature has provided theoretical foundations for the gravity model equation applied to trade flows on the basis of models of intra-industry trade and models of trade with heterogeneous firms (see Anderson and van Wincoop, 2003 and Helpman et al. 2008). But, "just about any plausible model of trade would yield something very like the gravity equation (Deardoff, 1998).

[13] For recent applications of gravity models to migration models see Herander and Saavedra (2005) and Jansen and Piermartini (2008).

weighted average of the bilateral distances between each country and the rest of the world, that is $remoteness_j = \sum_{i \neq j} \text{GDP}_i \cdot \text{distance}_{ji}$.

In addition, we expect cultural vicinity to increase passenger traffic between two countries. Like in the common practice in trade-related gravity models, we capture cultural proximity with the dummies for common colonial link (*colony*) and common language (*language*) and we expect these variables to have a positive impact on passenger traffic.

In the gravity models applied to trade flows, the dummy indicating whether two countries are adjacent (*border*) is in general estimated to be positive and significant. Instead, in the case of air transport services, we expect a negative impact of adjacency on the volume of passenger traffic. The reason is that the existence of a common border indicates the higher likelihood to use means of transport alternative to air transport (e.g. rail and road transport) to travel between these two countries than between two countries that do not share a border. In other words, substitutability between alternative means of transport is higher between nearby (adjacent) countries. Clearly, one reason is that the time required to reach the adjacent country is sufficiently low. An average person would not consider travelling by car from North of Canada to South of Argentina, while she/he may consider driving from North of Italy to Switzerland. The higher substitutability between air and road/rail transport among adjacent countries implies average lower transport costs between two countries and therefore more trade in goods, but it also implies a lower propensity to travel by air transport in favor of cheaper means of transport and therefore less trade in international air services.

As far as those measures of the gravity model that relate to the mass are concerned, we use GDP per capita (denoted by *GDPpc*) and population (*pop*) as proxies for country sizes. Both variables are commonly used in the trade-related gravity-type literature. We expect both variables to have a positive impact on passenger traffic. Clearly, the larger the population of two countries, the higher, everything else given, is the volume of passengers between these countries. In addition, a higher average level of income will make financially more viable the use of air transport and it is also likely to proxy better quality of air infrastructure. GDP per capita and air quality infrastructure are in fact highly correlated.

We augment the standard gravity model with a number of additional variables that are meant to capture characteristics specific to the demand for air transport services. These include: (i) the variable *low_income* (this is a dummy equal 1 if one and only one country in the pair is a low-income country) that is meant to capture the relatively low attractiveness of low income countries for passengers from other countries; (ii) total bilateral trade flows (*trade*), defined as the sum of bilateral exports and imports, in equation (1). We expect bilateral passenger traffic to be higher between countries that have a more important trade flow at least in two ways. First, trade relations in general increase the need for face to face communication with trade partners. Second, cargo is very often carried together with passengers; (iii) a dummy called *direct_service* that is 1 if a direct service exists (this variable denotes mainly non-stop flights, but flights with a stop-over are also included). We expect a positive coefficient for this variable since the cost in terms of time and ease of travel is less when there is a direct flight between two locations; and (iv) the number of years (*ASA_age*) since the first ASA has entered into force in order to control for the length of the ASA relationship. This variable attempts to account for the effective implementation of the agreement and the more likely realization of its pro-competition effects. We expect this variable to positively affect passenger flows.

As discussed above, in equation (1) we use *remoteness* to proxy for the multilateral resistance terms and capture the fact that bilateral trip distribution is a function of relative rather than absolute costs. As an alternative approach, Anderson and van Wincoop (2003) suggest to estimate the gravity model using country fixed effects to obtain unbiased estimates. This approach allows taking into account any country specific factor that explain differences in passenger volumes and that we may have omitted in equation (1). However, because of collinearity, we can no longer estimate the effect on bilateral passenger traffic of those variables that are country specific (such as GDP per capita, population and remoteness). We can only estimate the impact of those factors that are route-specific.

The resulting equation is then:

(2) $\ln(PassengerTraffic)_{ij} = \alpha + \beta_1 \ln(distance)_{ij} + \beta_2 border + \beta_3 colony + \beta_4 language + \beta_8 low\_income_{ij} + \beta_9 \ln(trade)_{ij} + \beta_{10} direct\_service_{ij} + \beta_{11} air\_liberalization_{ij} + \beta_{12} ASA\_age_{ij} + \Sigma_i \gamma_i D_i + \Sigma_j \gamma_j D_j + \Sigma_i \delta_i D_i * direct\_service_{ij} + \Sigma_j \delta_j D_j * direct\_service_{ij} + \varepsilon_{ij}$,
where Di denotes a dummy that is 1 for country i.

We estimate equation (1) and (2) using OLS, Tobit and Poisson estimation techniques and report the results in the next section. Tobit and Poisson methods take into account also zero passenger traffic and Poisson estimation also models heteroscedasticity in the data (Silva and Tenreyro, 2006).

Equations 1 and 2 are estimated for three samples: the full sample, the sample of country-pairs that are connected by a direct air service and that of country-pairs between which there are only indirect connections. Several reasons justify this distinction. First, our database provides a much larger coverage of country-pairs with direct flights (85 per cent covered) than country-pairs without direct flights (25 per cent covered). Second, our database does not allow to properly account for the regimes governing air services operating between two countries that are not linked by a direct services. When a direct service between two countries exists, we can reasonably assume that bilateral passenger traffic is regulated on the basis of the bilateral agreement signed by the two countries. In fact, case studies suggest that the number of passengers traveling via indirect routes when a direct service exists is a small percentage of total passenger flows. In contrast, when there is not a direct flight, the degree of air service liberalization defined in the agreement between two countries does not represent the conditions under which airlines operating the indirect connection work. To the extent that passengers from country A to country B travel via country C (unknown), the relevant ASAs are those between A and C and B and C. But, we cannot take this into account in the analysis. Finally, the role that standard variables of the gravity model (such as border and distance) play in explaining bilateral passenger flows may differ across samples. For instance, we may expect a larger negative effect of sharing a common border on passenger traffic between two countries without direct services than between countries connected by a direct service. The reason is that between countries without a direct service, the substitutability between air transport and other means of transport is stronger than between countries with a direct service link. Since indirect connections are more costly in terms of time required for travelling between two locations than direct connections, air transport via indirect connection is relatively less convenient than other means of transport in countries that share a border relative to non contiguous countries. Another example is that of distance. In the gravity model passenger flows between country A and country B is negatively correlated to the distance between the two countries. However, the distance between A and B is less than the effective distance covered by an indirect flight via country C. In particular, effective distance is likely to increase more than proportionally to the increase of direct distance between A and B. Therefore, distance will be a relatively more important determinant of passenger flows in the sample of countries connected through indirect services.

Data Sources

Data on distance, common border, common colonial link and common language were obtained from the CEPII database. Measures of the size of the economy such as GDP per capita, population and remoteness are based on the World Bank World Development Indicators' (WDI) database. Trade data are extracted from UN Comtrade database. Data on passenger traffic and the existence of direct services between two countries are from the International Aviation Transport Association (IATA). Information on the agreements and the number of years since they were first signed are from World Air Service Agreements (WASA) database provided by ICAO (ICAO, 2005). This database covers 2000 bilateral air service agreements. Information on regional agreements is obtained from QUASAR database (WTO, 2007). In particular, we include the Air Transport Agreement between EU and Switzerland and the Agreement on the European Economic Area involving the EU countries, Norway,

Iceland and Liechtenstein[14]. We ignore other regional agreements because their effective implementation is improbable (see WTO (2007), Add. 2, Introduction for more details). The informed index of air transport liberalization, the ALI, is from the QUASAR database (WTO, 2006 and 2007).

5. The results

In this section we present the results of our estimations. The section is divided in two parts. In the first part, we present the results obtained using measures of the overall degree of liberalization introduced by bilateral air service agreements. In the second part, we focus on the legal test and analyse the impact of individual provisions and of specific types of agreements.

(a) Evidence based on the overall degree of liberalization of the aviation market

Table 6 reports the estimates of the gravity model specified in equation (1) and (2). Results are presented for different estimation techniques: OLS, Tobit and Poisson. To account for heteroscedasticity, we run regressions with robust standard errors. Table 6 refers to estimations for the full sample of observations where information on ASA is coded. Iraq is dropped from the sample as data for flights from and to Iraq appears to be unreliable[15].

All coefficients of the explanatory variables have the expected sign and are significant. As expected, the number of passengers decreases with distance and increases with the size of the economy (i.e. with population or GDP per capita). Ceteris paribus, air passengers between countries that share a common border is less than between non adjacent countries. The existence of a direct service increases the flow of air passengers between two countries by approximately 6 times. Similarly, the sharing of common colonial links, a common language and the existence of an intensive trading activity are all factors that explain higher flows of passengers between two countries.

Turning to the role of liberalization of aviation markets, Table 6 reports the results based on the index of liberalization developed by the WTO Secretariat, the standard ALI (*ali_standard*). The results show a positive and, in general, significant effect of liberalization on passengers flows (the coefficient for *ali_standard* is not significant only in regressions without fixed effects, where there may be a bias due to omission of significant variable). In particular, an increase in the degree of liberalization as measured by the *ali_standard* from the 25th percentile (when *ali_standard* = 6) to the 75th percentile (when *ali_standard* = 15) is estimated to increase traffic volumes by approximately 5 to 6 per cent according to OLS and Tobit estimations with fixed effects, respectively, and by 10 per cent according to estimations obtained using Poisson and fixed effects. We also tend to find a positive and significant coefficient for the number of years since the first air service agreement was signed. This is in line with the prediction that the more years an agreement has been in place the more likely is that the legal provisions have been effective to liberalize. Agreements with *ASA_age* of 41 years (75th percentile) are related on average to traffic volumes around 20 per cent higher than those with *ASA_age* of 12 years (25th percentile).

[14] Although the regional EAA agreement is not introduced in WTO (2006), its main features regarding air transport services are the same as in the agreement on the European Common Aviation Area (ECAA) listed in WTO (2006) that entered into force in 2006.

[15] Iraq is dropped from the sample as data for flights from and to Iraq seems to be unreliable. For example, 13 countries including Germany, France or Belgium (for which direct service to Iraq exists) record no passengers to and from Iraq in 2005. We reckon this is more likely to denote missing information than real zero flow.

Table 6: Estimates for the gravity model on passenger flows, full sample

Coefficient	(1a) OLS	(1b) FE OLS	(2a) OLS	(2b) FE OLS	(3a) Tobit	(3b) FE Tobit	(4a) Poisson	(4b) FE Poisson
l_distance	-0.50***	-0.70***	-0.47***	-0.66***	-0.50***	-0.71***	-0.37***	-0.33***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
direct_service	1.96***	4.80***	1.95***	4.85***	1.96***	6.78***	1.28***	7.08***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
low_income	-0.37***	-0.22**	-0.38***	-0.23**	-0.36***	-0.15	-0.27**	-0.32**
	(0.00)	(0.04)	(0.00)	(0.04)	(0.00)	(0.16)	(0.03)	(0.01)
border	-0.49***	-0.57***	-0.51***	-0.57***	-0.56***	-0.60***	-0.68***	-0.58***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
l_trade	0.31***	0.27***	0.31***	0.27***	0.33***	0.25***	0.51***	0.69***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
colony	0.60***	0.39***	0.60***	0.40***	0.60***	0.40***	0.72***	0.34***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
language	0.68***	0.55***	0.65***	0.54***	0.67***	0.58***	0.37**	0.17*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.07)
lp_GDPpc	0.33***		0.32***		0.32***		0.19***	
	(0.00)		(0.00)		(0.00)		(0.00)	
lp_pop	0.32***		0.31***		0.30***		0.25***	
	(0.00)		(0.00)		(0.00)		(0.00)	
lp_remoteness	0.66***		0.74***		0.75***		0.73***	
	(0.00)		(0.00)		(0.00)		(0.00)	
ASA_age			0.0099***	0.0061***	0.010***	0.0067***	0.0044	0.0014
			(0.00)	(0.00)	(0.00)	(0.00)	(0.27)	(0.66)
ali_standard			0.0024	0.0067**	0.0012	0.0057**	0.018***	0.011***
			(0.35)	(0.02)	(0.66)	(0.04)	(0.00)	(0.01)
Constant	-19.2***	3.32***	-20.2***	2.77**	-20.4***	7.30***	-20.3***	1.93*
	(0.00)	(0.01)	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)	(0.07)
Observations	1959	2108	1959	2108	1966 (7)	2117 (9)	1966	2117
R^2	0.78	0.89	0.78	0.89	0.31	0.49	0.84	0.93

Note: Dependent variable is log(PassengersTraffic) in OLS models, log(PassengersTraffic) for PassengersTraffic>0 and -1 for PassengersTraffic = 0 in Tobit models, PassengersTraffic in Poisson models. Robust SE used. P-values reported in parenthesis. l_ denotes logarithm and lp_ denotes logarithm of product. Number of censored observations (y<0) presented for Tobit in parenthesis. Adjusted R^2 reported for OLS, pseudo R^2 presented for Tobit and Poisson models.

Table 7 shows the results for the estimations of the gravity model for two sub-samples: that of country-pairs with existing direct services and that of country-pairs for which a direct service does not exist. The table only reports the results for the regressions including fixed effects for the Poisson and the Tobit regressions. Since there are no-zero passenger flows between country-pairs where a direct service link exists, we do not run Tobit estimations in this case. The results for the sample with direct services confirm that an increase in the degree of liberalization increases bilateral passenger flows. In particular, an increase in *ali_standard* from the 25th percentile (when *ali_standard* = 6) to the 75th percentile (when *ali_standard* = 34[16]) corresponds to an increase in traffic volumes by approximately 18 per cent (according to the OLS estimations with fixed effects). In contrast, we do not find a significant impact of the degree of liberalization of air service agreement for the country-pairs without direct services. As discussed above, this is not surprising as the agreement signed by two countries between which there is not a direct service is not the relevant agreement for passenger traffic.

[16] Note that for the sub-sample of country-pairs with a direct air service the 75th percentile corresponds to a much higher value of the ali_standard than for the full sample.

There are few other interesting differences in the results for the two sub-samples of country-pairs with and without a direct service. One is that we find a stronger negative impact of sharing a common border on passenger flows for the sample without existing direct services than for that with a direct service. A plausible reason is that if there is not a direct service between two adjacent countries, people will be more likely to choose to travel by other means of transport, such us road or railways. Another difference is the higher coefficient (in absolute terms) for distance. That is, an increase in distance reduces passenger flows more between countries without a direct service than between countries with a direct service. As discussed above, this may be due to the fact that the actual distance covered by the indirect flight increases more than proportionally than the geographical distance between two countries.

Table 7: Estimates for the gravity model on passenger flows, country-pairs with and without existing direct services

Coefficient	**(1a)**	**(1b)**	**(2)**	**(3a)**	**(3b)**	**(4)**	**(5)**
	Existing direct services			**Non-existing direct services**			
	OLS	**FE OLS**	**FE Poisson**	**OLS**	**FE OLS**	**FE Tobit**	**FE Poisson**
l_distance	-0.43***	-0.60***	-0.31***	-0.60***	-0.77***	-0.91***	-0.55***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
low_income	-0.19*	-0.20*	-0.32**	-0.42***	-0.24	-0.046	-0.35
	(0.06)	(0.10)	(0.01)	(0.00)	(0.30)	(0.84)	(0.16)
border	-0.48***	-0.48***	-0.58***	-1.58	-1.80**	-1.97**	-1.28*
	(0.00)	(0.00)	(0.00)	(0.13)	(0.05)	(0.02)	(0.05)
l_trade	0.34***	0.34***	0.71***	0.25***	0.20***	0.18***	0.22***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
colony	0.66***	0.40***	0.34***	0.45	0.43	0.48	1.12***
	(0.00)	(0.00)	(0.00)	(0.47)	(0.33)	(0.21)	(0.00)
language	0.58***	0.42***	0.17*	0.89***	0.73***	0.86***	0.68***
	(0.00)	(0.00)	(0.08)	(0.00)	(0.00)	(0.00)	(0.00)
lp_GDPpc	0.23***			0.53***			
	(0.00)			(0.00)			
lp_pop	0.25***			0.45***			
	(0.00)			(0.00)			
lp_remoteness	0.79***			0.43*			
	(0.00)			(0.07)			
ASA_age	0.0046***	0.0055***	0.0013	0.021***	0.0067*	0.0081**	0.0018
	(0.01)	(0.00)	(0.67)	(0.00)	(0.07)	(0.02)	(0.65)
ali_standard	0.0077***	0.0059*	0.011***	-0.0018	0.0061	0.0036	-0.0061
	(0.00)	(0.06)	(0.01)	(0.73)	(0.30)	(0.54)	(0.35)
constant	-16.4***	8.48***	-0.20	-22.3***	9.01***	9.97***	7.67***
	(0.00)	(0.00)	(0.89)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	1195	1259	1259	764	849	858 (9)	858
R^2	0.68	0.79	0.91	0.55	0.80	0.40	0.87

Note: Dependent variable is log(PassengersTraffic) in OLS models, log(PassengersTraffic) for PassengersTraffic>0 and -1 for PassengersTraffic = 0 in Tobit models, PassengersTraffic in Poisson models. Robust SE used. P-values reported in parenthesis. l_ denotes logarithm and lp_ denotes logarithm of product. Number of censored observations (y<0) presented for Tobit in parenthesis. Adjusted R^2 reported for OLS, pseudo R^2 presented for Tobit and Poisson models.

Overall, the gravity model explains an important proportion of the variance of the data. In the OLS regressions (Table 6 and 7), the adjusted R^2 ranges between 55 and 89 per cent of overall variance. A comparison between the results for the regressions with and without fixed effects shows the importance of country heterogeneity in explaining overall variance (for example in Table 7, the R^2 increases from 0.68 to 0.79). The pseudo R^2 presented for Tobit and Poisson regressions cannot be

interpreted as proportion of the explained variance by the model, but they also suggest the importance of fixed effects in the model.

In addition, results appear robust across different estimation techniques. That is, when we allow to account for the existence of zero passengers flows (Tobit and Poisson) and alternative hypothesis on types of heteroscedasticity (OLS and Poisson with robust standard errors). The Poisson technique however appears to be inappropriate leading to biased coefficients, since it assumes that the variance increases proportionally to the mean, but this cannot be observed in our data. Hence, further results presented will rely on the OLS estimation with fixed effects.

Results are also robust to the use of different indexes for the overall degree of liberalization introduced by air service agreements. Table 8 shows the estimations for the four versions of the ALI and the *FA_index*. For all measures, for the full sample and in the sub-sample of country-pairs with direct services, the flow of passengers between two countries is positively and significantly correlated with the degree of liberalization of air transport services. The different magnitude of the coefficients for the ALI measures and the *FA_index* is explained by the scale of the indexes (all versions of the ALI range between 0 and 50, while the *FA_index* takes values between 0 and 1). When this is taken into account, the effects implied by similar liberalization policies are consistent. That is, for example, on the basis of the estimations obtained using the *FA_index*, an increase in degree of liberalization from the 25th percentile (*FA_index* = 0.08) to the 75th percentile (*FA_index* = 0.73) is estimated to increase traffic volumes between country-pairs with a direct service by 19 per cent. This is very similar to the predicted 18 per cent estimated using the *ali_standard*.

Table 8: The impact of ASAs on passenger flows: a comparison across different measures of the degree of liberalization

	(1) Full sample	(2) Existing direct services	(3) Non-existing dir. services
ali_standard	0.0067**	0.0059*	0.0061
	(0.02)	(0.06)	(0.30)
ali_5thfreedom	0.0072***	0.0051*	0.0094*
	(0.01)	(0.09)	(0.08)
ali_ownership	0.0063**	0.0057*	0.0056
	(0.05)	(0.10)	(0.39)
ali_designation	0.0062**	0.0063**	0.0040
	(0.03)	(0.04)	(0.48)
FA_index	0.29*	0.27*	0.24
	(0.06)	(0.10)	(0.46)
Observations	2108	1259	849

Note: Dependent variable is log(PassengersTraffic). The estimation method used is OLS with fixed effects and robust SE. P-values reported in parenthesis.

To sum up, there is robust evidence that liberalization in the aviation market increases passenger flows. The effect is driven by those agreements signed between countries where there is a direct service. There is in general not a significant effect of signing more liberal air services agreements on passenger flows between countries that are not serviced by a direct connection. The reason is quite intuitive: passenger traffic between countries without a direct flight is not regulated by the agreement signed by the two countries, but by the agreements signed by the countries involved in the indirect route. Only the provision for fifth freedom appears to play a role in this case (*ali_5thfreedom* presents a significant coefficient). One possible explanation may be that the right for 5th freedom makes it easier to introduce a direct service between countries without an existing direct service, thus increasing competition (in the way of contestable markets) on indirect routes.

(b) Evidence on the impact of individual provisions

Being an overall measure of the degree of liberalization, indexes do not provide an understanding of which provision has the largest impact on passenger flows. It is very difficult to disentangle the effect

of each provision on passengers flow, because of the high correlation among provisions. In order to shed some light on this, we also run gravity-type regressions for each component of the air service agreements. Table 9 shows the results of these regressions for the full sample and for the two sub-samples with and without existing direct services.[17] The table shows that several provisions have a significant effect on passenger traffic for the country-pairs with direct services. But, apart from 5th freedom there is no ASA provision that is correlated to passenger flows. In particular, cabotage, free determination of capacity, free pricing, multiple designation and no requirement for statistical exchange show up with a positive and significant coefficient, thus implying a positive relationship with passenger traffic. On the contrary, substantial ownership and effective control as well as the requirement of country of origin disapproval as to the pricing regime are associated to lower passenger flows.

Table 9: The impact of ASAs on passenger flows by individual component

Provision/Regime	Full Sample	Existing direct services	Non-existing direct services
Fifth Freedom	0.13*	0.043	0.23*
	(0.05)	(0.59)	(0.06)
Seventh Freedom	0.13	0.18	-0.021
	(0.30)	(0.17)	(0.94)
Cabotage	0.32**	0.28**	0.27
	(0.01)	(0.03)	(0.30)
Predetermination	-0.04	-0.087	0.083
	(0.52)	(0.22)	(0.46)
Bermuda 1	-0.04	-0.031	-0.12
	(0.57)	(0.69)	(0.35)
Free determination	0.18	0.24**	0.042
	(0.13)	(0.04)	(0.87)
Dual Approval	-0.16*	-0.10	-0.16
	(0.09)	(0.30)	(0.36)
Country of Origin Disapproval	-0.28*	-0.32*	-0.21
	(0.09)	(0.09)	(0.47)
Dual Disapproval	0.13	-0.023	0.28
	(0.25)	(0.86)	(0.21)
Zone Pricing	-0.03	-0.027	No obs.
	(0.85)	(0.88)	
Free Pricing	0.31**	0.37**	0.12
	(0.02)	(0.01)	(0.66)
Substantial Ownership and Effective Control	-0.21*	-0.28**	-0.095
	(0.05)	(0.02)	(0.62)
Community of Interest	0.16	0.18	0.070
	(0.20)	(0.20)	(0.78)
Principal Place of Business	-0.14	-0.052	-0.18
	(0.28)	(0.73)	(0.47)
Multiple Designation	0.04	0.14**	-0.098
	(0.45)	(0.04)	(0.32)
No Exchange of Statistics	0.15*	0.15*	0.12
	(0.06)	(0.09)	(0.39)
Cooperative Arrangements Allowed	-0.11	-0.18	0.018
	(0.39)	(0.18)	(0.94)
Observations	1850	1117	733

Note: Incomplete agreements are excluded. Estimates are based on OLS with fixed effects and robust standard errors. P-values are presented in parenthesis.

In order to address the issue of multicollinearity and understand which existing legal type of agreement is more liberalizing in the sense that it increases passengers flow the most, we turn to

[17] In order to be able to work with the same sample of observations in the analysis of various provisions, we do not include observations for incomplete agreements.

cluster analysis. Agreements are combinations of provisions. The overall effect of an agreement will depend on its specific design. Cluster analysis is a suitable tool to distinguish different types of agreements, because it classifies objects into different groups (clusters) according to their "similarity". In the analysis that follows, we use agglomerative hierarchical cluster analysis (see Härdle and Simar, 2003) that takes each observation as a separate cluster at the beginning and merges them successively into larger and larger clusters.

Using the components that are significant at the 5 per cent significance level in Table 9 (cabotage, free determination, free pricing, substantial ownership and effective control and multiple designation) as distinguishing features for the cluster analysis, the first level of aggregation reveals ten different types of existing agreements relevant for the country-pairs with existing direct services[18]. Table 10 part (1) displays these types ordered from the most restrictive to the most liberal type. In the Table they are identified as C1-C10 and the presence or the absence of a certain feature is denoted by a Yes or a No, respectively. Provisions are defined in a way that their presence (a Yes) denotes a liberal feature in the agreement. For example, no substantial ownership and effective control means the presence of the other two possible ownership regimes. Three types of agreements related to clusters C1, C4 and C9 are very frequent and account together for more than 90 per cent of the ASAs.

Table 10: The impact of ASAs on passenger flows by type of agreement

Part (1) The clusters										
provisions / clusters:	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
multiple designation	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
free determination	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes
no substantial ownership and effective control	No	No	Yes	No	No	Yes	Yes	No	Yes	Yes
free pricing	No	No	No	No	No	No	No	Yes	Yes	Yes
cabotage	No	No	No	No	No	No	No	No	No	Yes
observations	344	2	1	429	52	13	2	1	280	25
Part (2) The regression results for the first aggregation level										
coefficient	ref	-0.08	1***	0.11#	0.10	0.08	-0.12	-	0.42**	0.42**
p-value	ref.	0.54	0.00	0.13	0.67	0.75	0.64	-	0.01	0.04
Part (3) The regression results for the third aggregation level										
coefficient	ref.				0.10*			-	0.42**	
p-value	ref.				0.07			-	0.01	

Note: # denotes 15 per cent significance level. Incomplete agreements are excluded. Ref denotes the agreement of reference. The p-values in part (3) refer each to a one-sided t-test of null hypothesis that the coefficient of interest is smaller or equal to the coefficient more to the left (i.e. 0 in case of the reference group).

Using the gravity model to explain bilateral passengers flow, we estimate the impact of different types of agreement by adding to the standards explanatory variables ten dummies, one for each type of agreement. Table 10 part (2) shows the results of the regressions. The agreements falling in clusters C3, C4, C9 and C10 are the only clusters that appear to have a positive and significant effect on passengers flow. These results suggest two important conclusions. First, they indicate that ASAs that introduce multiple designation have a positive impact on passengers flow. The significant coefficient for cluster C3 is hard to generalise as it only refers to one observation, but it points at the importance of setting up a regime that does not require substantial ownership of airlines. This is in line with the perception of industry commentators that have identified national ownership rules (as well as merger policy and airport pricing) as one of the most important factor in limiting adjustments in the international air transport industry (Findlay and Round, 2006). Second, a part from multiple

[18] The application of cluster analysis is redundant for country-pairs without existing direct services because one distinguishing feature (potentially 5th freedom, significant at 10 per cent) would lead only to two types of agreements, namely to agreements with and without 5th freedom.

designation, ASAs need to include free determination, free pricing and no substantial ownership, if they have to have a significant impact on passengers flows.

We also investigate higher levels of cluster aggregation. When only three clusters are distinguished, where the first cluster includes the most restrictive types of agreements (namely, C1, C2 and C3) characterised by single designation, the second cluster includes semi-liberal types of agreements (namely, C4-C7) characterised by multiple designation and the third cluster incorporating the most liberal types, namely C9 and C10. Table 10 part (3) shows the results of the regressions for these three clusters. We find a stronger impact on trade for the more liberal types of agreements. Countries that signed agreements involving multiple designation have approximately 11 per cent more bilateral passenger traffic than countries, where multiple designation is not allowed. The introduction of free determination, free pricing and relaxation of substantial ownership as well as effective control in addition to multiple designation boosts passenger traffic by roughly 41 per cent.

6. Conclusions

International air passenger transport is an important factor in facilitating trade and development of other sectors of an economy (such as tourism). The airline industry transport passengers both on scheduled and charter flights, but scheduled transportation account for about 85 per cent of passenger traffic (Gonenc and Nicoletti, 2000). The industry has been highly regulated both domestically and internationally, with governments setting conditions ownership, capacity and fares. Declared policy objectives include safety, national prestige and regional development. But the outcome of this regulation has been a highly restrictive global aviation market.

In the last 30 years countries have undertaken a process of liberalization of the industry. This has taken place mainly through bilateral air service agreements and few regional agreements. Some 3500 agreements have been signed involving more than 180 countries. Little progress has been made at the multilateral level. At the exception of aircraft repair and maintenance services, selling and marketing of air transport services and computer reservation system services, "core" air transport services remain excluded from GATS.

It is very difficult to get a measure of the degree of liberalization introduced by this plethora of ASAs. Recently, the WTO Secretariat has developed an index of bilateral air service liberalization based on consultations with industry experts. This is the first available index covering a wide range of bilateral agreements (involving over 180 countries) and it is the only informed index available for the industry. Previously developed indexes were developed through statistical techniques and cover at best 35 countries.

In order to assess the effective degree of liberalization of the aviation market introduced by bilateral air service agreements, this paper uses the index built by the WTO Secretariat and additionally builds a statistical index (by means of factor analysis) that cover the same range of countries. In particular, few studies look at the impact of regulation on industry performance. By exploring the impact of air service liberalization of passenger traffic this paper fills this gap.

We find robust evidence of a positive and significant relationship between the passenger traffic and the degree of liberalization (in terms of market access conditions) of the aviation market. As has to be expected, liberalization is found to have a stronger impact for countries connected by a direct service than for country-pairs without a direct service link. In particular, we estimate that increasing the degree of liberalization from 25th to 75th percentile increases traffic by 18 per cent.

We are also able to explore the contribution that specific provisions have on passenger flows. We find that switching from single to multiple designation is associated with an increase in traffic volumes by 11 per cent. Furthermore, the additional introduction of free pricing together with free determination of capacity and liberal ownership regimes increases traffic by an additional 41 per cent.

As far as agreements between countries that are not linked by a direct air service are concerned, we find, consistently with the theory of contestable markets, some evidence that 5th freedom right has a significant and positive effect on passengers flows.

In conclusion, we find evidence that regional and bilateral air service agreements have extended air services to a broader consumer base. However, there is a very heterogeneous degree of liberalization of air service agreements and most bilateral air services tend to be restrictive. The highest levels of liberalization are reached in the context of regional agreements. In this context a multilateral agreement would be likely to foster the creation of a global aviation market and network optimization by carriers.

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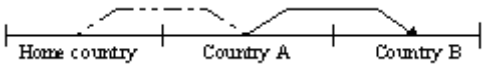
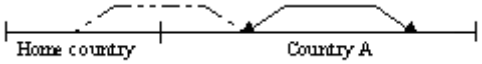
Appendix

Table A1: Indicators of openness and their categories

Name	Meaning	
freedoms	sum of the three **traffic rights** 5th freedom, 7th freedom and cabotage normalized to 1; i.e. *free0123* = (*freedom5* + *freedom7* + *cab*)/3	
freedom5	1 if **5th freedom**; i.e. freedom to carry freight/ passengers between two countries by an airline of a third country on route with origin/destination in its home country	
freedom7	1 if **7th freedom**, i.e. right to carry freight/ passengers between two countries by an airline of a third country on a route with no connection with its home country	
cab	1 if **cabotage** right; i.e. right to carry freight/ passengers within a country by an airline of on a route with origin/destination in its home country	
capacity	categories of **capacity regimes** (0-*pd*, ¼ -*other_rest*, ½-*b1*, ¾-*other_lib*, 1-*fd*)	
pd	1 if **predetermination** of capacity, i.e. capacity be agreed to prior to the commencement of the operation (either by governments, or their aeronautical authorities or designated airlines subject to government approval)	
b1	1 if **Bermuda I** capacity, i.e. the governments set out the capacity principles for the designated airlines to follow but allow each airline the *ab initio* freedom to determine its own capacity, subject only to *ex post fact* review by the governments through their consultation procedure	
fd	1 if **free determination** of capacity, i.e. capacity 0 free of regulatory control	
other_rest, other_lib	1 if capacity and related provisions cannot be classified as any one of the above three types of capacity arrangements, being a hybrid of more than one or not identifiable as any one of them. Two types, **"other restrictive"** and **"other liberal"** are distinguished.	
pricing	categories of **pricing regimes** (0-*da*, 3/8-*co*, 4/8 -*zp* combined with *da*, 6/8-dd, 7/8-*zp* combined with *dd*, 1-*fp*)	
da	1 if **dual approval**, i.e. approval by both parties of tariffs or agreement on tariffs before those tariffs can take effect	
co	1 if **country of origin disapproval**; i.e. a party may disapprove tariffs only for originations in its own territory	
dd	1 if **dual disapproval**; i.e. tariffs become effective unless both aeronautical authorities disapprove them	
zp	1 if **zone pricing**; i.e. this regime involves a reference point or points (zones) around which various types of tariff control are agreed. Tariffs are to be approved within the zone. Outside the zone, either free pricing and dual approval or free pricing and dual disapproval are combined.	
fp	1 if **free pricing**; i.e. tariffs shall not be subject to the approval of any party	
withhold	categories of **ownership/withholding regimes** (0-*wh1*, ½-*wh2*, 1-*wh3*); when more than 1 regime included, the less-restrictive one is preferred	
wh1	1 if **substantial** ownership and effective control are vested in the designating party or its nationals	
wh2	1 if **community of interests** regime, i.e. a foreign designated airline would be accepted to operate the agreed services under the condition that substantial ownership and effective control is vested: a) in a joint operating organization or a multinational carrier created by intergovernmental agreement b) in a one or more countries that are within a predefined group with a "community of interest"	
wh3	1 - a foreign airline is accepted if the carrier is incorporated in the designating party and its **principal place of business** or permanent residence is also in the designating party	
design	1 if **multiple designation**, i.e. each party may designate one or more airlines; 0 if **single designation**, i.e. each party may designate one airline	
statistics	0 if provision on the **exchange of statistics is included**, the exchange of statistics may be mandatory, upon request or required only in cases of disputes over capacity; 1 if absence of the provision	
coop	1 if **cooperative arrangements** allowed, i.e. presence of a provision for entering into cooperative marketing arrangements such as blocked-space and code-sharing	

Note: Source is the WASA database (ICAO, 2005) and QUASAR database (WTO, 2006 and 2007).

Table A2: Weights assigned to each component of the ASA in the construction of the Indexes of air service liberalization

Provision/Regime	ALI								*FA_index*	
	ali_standard		*ali_5thfreedom*		*ali_ownership*		*ali_designation*		Ex ante weights	Ex post weights
GRANT OF RIGHTS										0.17
Fifth Freedom	6		12		5		5.5		1/3	0.057
Seventh Freedom	6		5		5		5.5		1/3	0.057
Cabotage	6		5		5		5.5		1/3	0.057
CAPACITY										0.17
Predetermination	0		0		0		0		0	0
"Other restrictive"	2		1.5		1.5		1.5		1/4	0.043
Bermuda I	4		3.5		3.5		3.5		1/2	0.085
"Other liberal"	6		5		5		5.5		3/4	0.13
Free Determination	8		7		7		7.5		1	0.17
TARIFFS										0.18
Dual Approval	0		0		0		0		0	0
Country of Origin	3		2.5		2.5		2.5		3/8	0.07
Dual Disapproval	6		5		5		5.5		3/4	0.14
Zone Pricing	8	4	7	3.5	7	3.5	7.5	3.5	1/2	0.09
		7		6		6		6.5	7/8	0.16
Free Pricing	8		7		7		7.5		1	0.18
WITHHOLDING										0.1
Substantial Ownership and Effective Control	0		0		0		0		0	0
Community of Interest	4		3.5		7		3.5		1/2	0.05
Principal Place of Business	8		7		14		7.5		1	0.1
DESIGNATION										0.08
Single Designation	0		0		0		0		0	0
Multiple Designation	4		3.5		3.5		7.5		1	0.08
STATISTICS										0.11
Exchange of statistics	0		0		0		0		0	0
No exchange of stats	1		1		1		1		1	0.11
COOPERATIVE ARRANGEMENTS										0.19
Not allowed	0		0		0		0		0	0
Allowed	3		2.5		2.5		2.5		1	0.19
TOTAL	**50**		**50**		**50**		**50**		1	1

Note: Weights for different versions of ALI are based on WTO (2006). Weights for FA_index are based on the results of factor analysis. Missing values are treated as if they belonged to the most restrictive regime.

Table A3: Air liberalization indexes: average by country

Country	Our data				
	ali_standard		*FA_index*		
	rank	average	rank	average	partners
Angola	1	0.67	15	0.08	3
Papua New Guinea	2	3.60	6	0.06	5
Mozambique	3	3.67	5	0.06	6
Burkina Faso	4	3.71	14	0.07	7
China	5	3.73	13	0.07	73
Georgia	6	3.83	20	0.08	6
Sao Tome And Principe	7	4.00	17	0.08	1
Lesotho	7	4.00	1	0.05	8
Central African Republic	9	4.25	16	0.08	4
Yemen	10	4.33	9	0.07	6
Ukraine	11	4.53	39	0.10	17
Togo	12	4.62	2	0.05	13
Niger	13	4.63	19	0.08	8
Moldova	14	4.71	32	0.10	17
Iran, Islamic Rep. Of	15	4.74	18	0.08	31
Kazakhstan	16	4.83	38	0.10	6
Cameroon	17	4.89	22	0.08	9
Zimbabwe	17	4.89	37	0.10	9
Bahamas	19	5.00	118	0.19	1
Solomon Islands	19	5.00	8	0.07	2
Fyr Macedonia	21	5.27	48	0.11	11
Kuwait	22	5.35	7	0.07	23
Bangladesh	23	5.50	21	0.08	16
Zambia	24	5.60	28	0.09	10
Seychelles	25	5.70	11	0.07	10
Israel	26	5.72	36	0.10	32
Russian Federation	27	5.78	56	0.12	94
Benin	28	5.81	44	0.11	16
Oman	29	5.82	29	0.09	34
Kyrgyz Republic	30	5.93	46	0.11	14
Mauritius	31	5.94	12	0.07	16
Comoros	33	6.00	4	0.06	2
Guyana	33	6.00	3	0.06	3
Congo	33	6.00	34	0.10	19
Korea, Dem. People's Rep. Of	35	6.17	26	0.09	6
India	36	6.25	27	0.09	73
Kenya	37	6.32	10	0.07	25
Somalia	38	6.33	30	0.09	3
Libyan Arab Jamahiriya	39	6.45	24	0.08	11
Algeria	40	6.47	51	0.12	17
Samoa	41	6.50	23	0.08	4
Uzbekistan	41	6.50	81	0.15	38
Bulgaria	43	6.57	49	0.12	30
Côte D'ivoire	44	6.64	25	0.09	22
Lao People's Dem. Rep.	45	6.67	66	0.14	6
Burundi	45	6.67	41	0.11	9
Cuba	47	6.68	35	0.10	31
Bosnia And Herzegovina	48	6.75	60	0.13	4
Vietnam	48	6.75	59	0.13	20
Senegal	50	6.76	47	0.11	21

Country	Our data				
	ali_standard		*FA_index*		
	rank	average	rank	average	partners
Romania	51	6.78	42	0.11	46
Saudi Arabia	52	6.95	50	0.12	19
Mauritania	53	7.00	58	0.12	11
Albania	54	7.14	116	0.19	7
Nigeria	55	7.20	31	0.09	20
Fiji	56	7.22	43	0.11	18
Equatorial Guinea	57	7.25	67	0.14	4
Croatia	57	7.25	71	0.14	12
Afghanistan	59	7.29	65	0.14	14
Pakistan	60	7.34	33	0.10	53
Ethiopia	61	7.43	40	0.10	14
Mexico	62	7.44	123	0.20	32
Serbia And Montenegro	63	7.58	100	0.17	40
Tanzania	64	7.62	75	0.15	13
Azerbaijan	65	7.67	117	0.19	3
Morocco	66	7.84	64	0.14	51
Mali	67	7.86	74	0.15	21
Iraq	68	7.98	55	0.12	54
Saint Kitts And Nevis	69	8.00	94	0.16	1
Chad	69	8.00	52	0.12	3
Maldives	71	8.08	61	0.13	13
Turkmenistan	72	8.13	104	0.17	8
Belarus	73	8.15	76	0.15	13
Malawi	74	8.19	54	0.12	16
Thailand	75	8.40	53	0.12	50
Guinea-Bissau	77	8.50	78	0.15	2
Bahrain	77	8.50	82	0.15	32
Philippines	77	8.50	95	0.16	38
Colombia	79	8.55	125	0.20	11
Korea, Republic Of	80	8.58	72	0.14	45
Argentina	81	8.58	83	0.15	19
Tonga	82	8.67	45	0.11	3
Bolivia	83	8.69	86	0.16	16
Myanmar	84	8.73	68	0.14	37
South Africa	85	8.73	91	0.16	52
Gabon	86	8.75	77	0.15	8
Tunisia	87	8.78	114	0.18	36
Turkey	88	8.89	99	0.17	46
Bolivarian Rep. Of Venezuela	89	8.93	89	0.16	14
Armenia	90	9.00	80	0.15	5
Syrian Arab Republic	91	9.03	121	0.20	30
Guinea	92	9.06	90	0.16	16
Cambodia	93	9.07	85	0.16	14
Egypt	94	9.08	69	0.14	40
Congo, Dem. Republic Of	95	9.08	79	0.15	12
Jordan	96	9.29	115	0.19	31
Barbados	97	9.38	92	0.16	13
Qatar	98	9.42	108	0.17	19
Botswana	99	9.44	124	0.20	9
Sri Lanka	100	9.48	88	0.16	25
Canada	101	9.51	97	0.17	45

Country	Our data				
	ali_standard		*FA_index*		
	rank	average	rank	average	partners
Lebanon	102	9.68	102	0.17	41
Nepal	103	9.75	73	0.15	12
Malaysia	104	9.79	87	0.16	39
Bhutan	105	10.00	62	0.13	1
Djibouti	105	10.00	62	0.13	1
Tuvalu	105	10.00	70	0.14	2
Suriname	105	10.00	57	0.12	3
Paraguay	105	10.00	122	0.20	15
Ecuador	110	10.08	120	0.19	12
Sudan	111	10.09	106	0.17	11
Brazil	112	10.17	103	0.17	36
Uganda	113	10.20	112	0.18	10
Mongolia	114	10.22	111	0.18	9
Costa Rica	115	10.25	142	0.27	12
Sierra Leone	116	10.38	93	0.16	8
Australia	117	10.38	84	0.16	42
Liberia	118	10.42	119	0.19	12
Ghana	119	10.46	98	0.17	26
Uruguay	120	10.47	96	0.16	15
Indonesia	121	10.52	105	0.17	25
Brunei Darussalam	122	10.74	113	0.18	34
Japan	123	10.80	107	0.17	51
Peru	124	10.93	133	0.23	15
Cape Verde	125	11.00	140	0.27	3
Trinidad And Tobago	125	11.00	110	0.18	13
United Arab Emirates	127	11.10	128	0.21	20
Dominican Republic	128	11.25	138	0.25	8
Jamaica	129	11.32	132	0.23	19
Cook Islands	130	11.33	101	0.17	3
Rwanda	131	11.40	134	0.23	5
Guatemala	132	11.43	135	0.24	7
Panama	133	11.75	143	0.27	16
Madagascar	134	11.80	139	0.25	5
Hong Kong, China	135	11.98	109	0.18	50
Saint Lucia	136	12.00	126	0.20	3
Namibia	136	12.00	149	0.30	3
Nicaragua	138	12.20	137	0.25	5
Singapore	139	12.29	127	0.21	68
Vanuatu	140	13.00	136	0.24	3
Gambia	140	13.00	144	0.27	4
Swaziland	143	14.00	129	0.22	1
Antigua And Barbuda	143	14.00	129	0.22	1
Haiti	143	14.00	129	0.22	1
New Zealand	145	15.68	147	0.28	34
Nauru	146	15.75	146	0.28	4
American Samoa	147	16.00	141	0.27	1
Honduras	147	16.00	163	0.42	3
Chile	149	16.08	158	0.35	26
Macao, China	150	16.61	145	0.28	31
Switzerland	151	16.93	148	0.29	105
Austria	152	17.42	152	0.31	86

Country	Our data				
	ali_standard		***FA_index***		
	rank	average	rank	average	partners
Marshall Islands	153	17.67	155	0.32	3
Germany	154	17.77	151	0.31	104
Netherlands	155	17.83	154	0.32	107
Spain	156	17.98	153	0.32	85
Grenada	157	18.00	150	0.31	2
United Kingdom	158	18.93	157	0.34	114
Belgium	159	19.17	156	0.33	90
France	160	20.13	159	0.35	86
Sweden	161	21.53	160	0.38	77
Italy	162	22.78	161	0.41	60
Czech Republic	163	22.93	164	0.42	68
Denmark	164	23.09	162	0.41	69
El Salvador	165	23.50	177	0.60	2
Norway	166	24.20	166	0.44	64
Cyprus	167	24.90	165	0.43	49
United States	168	24.96	176	0.60	98
Poland	169	26.65	167	0.47	48
Finland	170	26.75	168	0.48	52
Greece	171	28.67	169	0.50	45
Portugal	172	28.87	171	0.52	46
Hungary	173	28.89	170	0.51	44
Luxembourg	174	30.57	172	0.55	46
Malta	175	32.92	173	0.59	38
Slovenia	176	33.74	174	0.60	35
Latvia	177	33.75	175	0.60	36
Aruba	178	34.00	183	0.80	1
Netherlands Antilles	178	34.00	183	0.80	1
Ireland	180	35.00	178	0.63	35
Lithuania	181	35.55	179	0.63	33
Slovak Republic	182	35.88	180	0.64	34
Iceland	183	39.06	181	0.71	32
Estonia	184	41.43	182	0.74	28