Air traffic development in ASEAN: an airport capacity analysis

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ABSTRACT

The ASEAN Member States have decided to sign agreements which define the milestones for liberalization of air transport in the region (January 2015). The air transport liberalization up to the 5th freedom right therefore removes the frequency and capacity constraints existing in bilateral air service agreements between ASEAN member states. The interesting question is then whether to know if the liberalization will lead to benefits for the economies of the countries. These benefits could only occur if some conditions are fulfilled: the air transport sector has to be able to receive more traffic.

We propose in this paper a relevant methodology to analyse the conditions under which liberalization would benefit to the development of air traffic. This analysis is focused on the airports as they represent the bottleneck of the air transport activity. We then, using data from the OAG database and from the ministry of transport, apply our analysis to the Indonesian market.

KEYWORDS

Liberalization, air transport, airport capacity

Introduction

The ASEAN Member States have decided to sign agreements which define the milestones for liberalization of air transport in the region. Whereas not all of the countries have reached the same level of ratification, they however have all made steps towards larger liberalization.

Two multilateral agreements have been set up in ASEAN, and will lead to the “Air transport liberalization” objective. The first, in 2008, is the Multilateral Agreement on Air Services (MAAS), the second, in 2010 is the Multilateral Agreement for the Full Liberalization of Passengers Air Services (MAFLPAS). The MAAS concerns the relaxation of 3rd, 4th and 5th freedom rights between capitals cities. The second agreement (MAFLPAS) concerns the relaxation of 3rd, 4th and 5th freedom rights between all other cities.

The air transport liberalization up to the 5th freedom right therefore removes the frequency and capacity constraints existing in bilateral air service agreements between ASEAN member states. ASEAN airlines will potentially be able to operate from all international airports in ASEAN without any frequency or aircraft capacity constraint. Without such
restrictions, airlines are expected to expand their network in offering more destinations, to compete in their existing network by offering more frequencies, reducing the ticket prices, increasing the quality of their services.

When studying the impacts of air transport liberalization in Europe on airline competition, Dobruszkes (2009) stresses the fact that “the saturation of a number of European airports is a strong barrier to the entry of new carriers or to the extension of existing ones”. Oliveira, Lohmann, & Costa (2015) also highlight the combine role of airline activity concentration and airport congestion in generating entry barriers for airlines. They illustrate their work by considering the case of the Brazilian air transport market in the 2000s, when main competing airlines concentrated their activity on some airports facing strong saturation issues.

So far no analysis focused on the current and potential entry barriers for airlines on the ASEAN air transport market has been made. Our paper aims to fill this gap by highlighting the important role of airport capacity in the analysis of ASEAN liberalization. Actually, while being known as a key issue, few authors have so far studied the role of airport capacity level in the increase of the air transport market competitiveness. Fageda & Fernandez-Villardangos (2009) analyze the impacts of both the increase in airport capacity and the entry of Low-Cost carriers on airline competition. From a demand-supply system applied on Spanish air traffic data, they show that capacity growth at large airports only increases competition level between airlines on routes departing from non-hub airports. Authors however focus on past situations and do not study the link between airport capacity constraints and the future air traffic development. This issue is considered by Gelhausen M., Berster, & Wilken (2013) who analyze the airport capacity constraints in the global air transport network, by comparing traffic with capacity for the largest 1000 airports in the world. They estimate that given available airport traffic forecasts, 70% of all flights to and from the top 177 airports will take-off and land at airport with capacity issues in 2016. Authors assume that many airports will have the means to enlarge their physical capacity. Nevertheless, they do not consider the case where capacity investments are not or lately made and the following impacts on potential non-accommodated demand at these airports.

Our study aims to present a methodology to analyze the effect of the air transport liberalization on the organization of air traffic. We focus on an airport capacity analysis which allows conclusions concerning the ability for new entrants to develop their activity following the air transport liberalization. The originality of our paper is to take care about capacity investment planning by 2020 for some ASEAN airports. Such assessment associated with the analysis of airline market share concentration provides an innovative work on the potential breaks in the future development of air transport in ASEAN countries with a specific focus on Indonesia.

1. **Methodology**

The liberalization of the air transport sector is meant to facilitate the circulation of passengers in the region. This also means that the traffic is expected to grow (at least maintains its level and even most probably increases). This is for instance what happens in both the American

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and European markets after the liberalization. However, these expected gains from liberalization can be limited if the conditions for liberalization are not carefully respected. Indeed, they could exist several brakes like entry barriers due to local dominant positions, or mis-specification of the market capacity to welcome the new traffic increase (like if airports capacity is limited). The specificities of the air transport market subject to the liberalization have thus to be considered in order for all the benefits of the liberalization to be derived.

Our analysis proceeds in three steps. First, we define the current air transport market, its evolution (over 10 years), its players (airlines, airports, State), its structure (intra-ASEAN traffic, extra-ASEAN traffic, domestic traffic). We use a community analysis which shed the light on the major role of given airports in each country.

Then, we analyse the role of airlines at airport level to identify if barriers to entry can already be identified. We provide an airport capacity analysis to identify if the main international airports are able to receive additional traffic forecasted by countries. The flows at each airport are analysed, their evolution, their perspective. We also analyse the role of the airlines at airport level computing the Hirschman Herfindhal Index.

Finally, we provide an analysis of airport capacity in order to evaluate whether the main international airports concerned by the liberalization are able to receive additional traffic as forecasted by the countries. Airport capacity is analysed at the terminal level. Indeed, we do not have precise data on the movements of aircraft at each main international airport All future investments are taken into account and we make recommendations for 2020.

This analysis is made from data collected from two main sources: countries and OAG database. A database was built from data provided by ASEAN states:
- Passenger traffic flows between national airports and passenger traffic flows between national airports and foreign airports;
- Passenger traffic at the airport level, split into domestic and international traffic;
- Passenger traffic forecasts per airport up to 2020,
- Airport terminal capacity forecasts up to 2020.

However, these collected data did not provide flows statistics per airline. The database was therefore completed with OAG database statistics on the number of supplied seats per route and per airline.

To illustrate our method, the analysis is made for Indonesia.

2. Results

The air traffic to and from ASEAN airports is in a strong development phase, with an increase of 83% in the number of passengers in only 7 years (2004-2011). In 2011, the total traffic through ASEAN airports reached 330 million passengers. One particularity of the ASEAN air traffic is the strong importance of domestic traffic (within one country) which represents 53% of the total traffic in 2011, despite the absence of domestic traffic in Brunei or Singapore.

a. The Indonesian air transport market

Indonesia is a vast and very populous country, composed of many islands. It is a major destination for tourists. The use of air transport is highly developed, for both domestic and international market.
Numerous bilateral air service agreements exist. Some are very close to open sky agreements (as in the USA). The MAAS agreement was ratified in 2014. Five major capital cities opened their access to local markets. Our analysis will focus on these entry points that are liberalized by the new agreements for ASEAN countries in the process of constituting a single market in ASEAN.

There are 21 Indonesian airlines among scheduled carriers, and 47 charters. The two major companies are Garuda Indonesia and Lion Air.

To analyse the market and the network of existing connections in Indonesia, we use a graph analysis representing the flows of passengers at each airport coming into or going out of Indonesia. The figures used to compute the following graph are airport flows.

Each node or vertex corresponds to an airport. Each edge corresponds to a connection with positive passenger traffic. Each arrow indicates the direction of the connection.

![Figure 1: Network of existing connections in Indonesia (Source of data from Indonesian Civil Aviation)](image)

The graph colors indicate the geographical location of the different airports served from Indonesia:

- blue boxes = non-ASEAN airports,
- red boxes = ASEAN airports,
- green boxes = Indonesian airports.

Traffic in Indonesia is organized through 141 different airports and 1388 connections (two ways). Figure 1 shows the complexity of the network existing in Indonesia. Jakarta Soekarno Hatta (CGK) is the airport with the highest number of connections (145), followed by Denpasar airport (DPS) with 89 connections, Juanda International Airport (SUB) with 66 connections, Hasanuddin International Airport (UPG) with 53 connections, Hang Nadim
Airport (BTH) with 43 connections and Polonia/Kuala Namu airport with 41 connections. Soekarno-Hatta is highly connected.

A significant amount of traffic is operated within Indonesia (number of green nodes). Connections with ASEAN airports and outside ASEAN airports are equally developed. The network is very dense, centered around Soekarno-Hatta.

A community refers to the division of the vertices into groups, or clusters, according to the pattern of the edges in the network\(^\text{2}\). For further information on referent works on the use of community algorithms to interpret networks, see Fortunato (2010) and Malliaros, Vazirgiannis (2013).

Figure 2 shows 4 communities.

- Red community: centered on CGK, and also contains DPS and KNO,
- Yellow community: contains SUB and UPG and is less centered on a particular airport,
- Purple and orange communities are smaller.

\(^{2}\) Loosely stated, identifying communities is the problem of finding the natural divisions of a network into groups of vertices such that there are many edges within groups and few edges between groups. However, robustness problems may arise: how we interpret the terms “many” or “few”? So a various different algorithms for community detection have been proposed. Furthermore, the number of communities or size of the groups is not fixed.
The 4 communities are not independent one from each other. All the traffic outside Indonesia (intra or extra ASEAN) is included in the red community. The figure shows that the traffic is very linked to Jakarta Soekarno-Hatta airport.

**b. Market concentration analysis**

There are 29 declared international airports in Indonesia. However, only half of them have some international activity. All airports are state-owned. Airports are regulated through a dual till principle: the regulator considers the revenues and costs related to the aeronautical activity when setting the price cap. The slots are allocated on a first come first served basis by the airports themselves.

In order to better understand how the traffic is organized in Indonesia we decide to focus our analysis on the 5 main airports of the country: Soekarno-Hatta (CGK), Kuala Namu (KNO), Ngurah Rai (DPS), Juanda International (SUB) and Hasanuddin International (UPG) airports.

We also analyse the role of the airlines at airport level computing the Hirschman Herfindhal Index (HHI)

\[ HHI = \sum_{i=1}^{N} s_i^2 \]

where \( s_i \) is the market share (in terms of number of seats) of the airline \( i \) in the market, and \( N \) is the number of airlines.

The HHI ranges from \( 1/N \) to one. For a convenient presentation of the result, we multiplied the H by 1000.

1. A HHI below 100 indicates a highly competitive index.
2. A HHI below 1,500 indicates an unconcentrated index.
3. A HHI between 1,500 to 2,500 indicates moderate concentration.
4. A HHI above 2,500 indicates high concentration.

It enabled us to characterize the concentration on the market in order to evaluate the possibility of entry of new airlines. Table 1 presents the computed HHI for each of the five main Indonesian airports for the year 2013.

<table>
<thead>
<tr>
<th>Airport</th>
<th>Soekarna-Hatta (CGK)</th>
<th>Kuala Namu (KNO)</th>
<th>Ngurah Rai (DPS),</th>
<th>Juanda Intl (SUB)</th>
<th>Hasanuddin Intl (UPG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHI</td>
<td>2427</td>
<td>2517</td>
<td>1392</td>
<td>2930</td>
<td>3992</td>
</tr>
</tbody>
</table>

**Table 1: Hirschman Herfindhal Index (HHI) of the main Indonesian airports in 2013**

Ngurah Rai airport is the only one among the fifth airports for which the market is unconcentrated. The reason is that no airline has a dominant position at the airport: while representing 25% of the total supplied seats, Garuda has the most important market shares while Lion Air comes second with 21%. This could mean that, except if the airport is congested, there is no specific barrier to entry for new airlines at DPS.
Market concentration at Soekarno-Hatta and Kuala Namu is moderate with a HHI of 2427 and 2517 respectively. If the computation is made taking into account the fact that some of the operating firms are subsidiaries of others, the result increases up to 2660 for Soekarno-Hatta which is classified by Competition Authorities in Europe and in the United States, as a high concentrated market. In particular, it means that new entrants may not be able to enter the market and supply high capacity.

The market at Hasanuddin International and Juanda International airports is highly concentrated with a HHI of 3992 and 2930 respectively. This can be explained by the very dominant position of Lion Air supplying 58% of the total seats at UPG and 50% at SUB. Entering the market or developing its supply might be difficult if both airports are already congested.

Further analysis of available capacity is therefore needed to confirm potential barriers to entry on Indonesian airports.

c. Airport capacity analysis

Table 2 summarizes the maximum terminal capacity in 2014 of the 5 main international airports in Indonesia. We combine the information on airport capacity with passenger forecasts provided by Indonesian Civil Aviation in order to analyze the ability of airports to receive potential influxes.

<table>
<thead>
<tr>
<th>Airport name</th>
<th>2014 maximum terminal capacity per year</th>
<th>Expansion plan and future maximum terminal capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jakarta Soekarno-Hatta</td>
<td>22 million passengers</td>
<td>47 million passengers from 2016 with the extension of Terminal 3</td>
</tr>
<tr>
<td>Denpasar Bali</td>
<td>9 million passengers</td>
<td>34 million passengers from 2016 with the building of a new terminal</td>
</tr>
<tr>
<td>Juanda Udara Surabaya</td>
<td>7 million passengers</td>
<td>12 million passengers from 2012</td>
</tr>
<tr>
<td>Kuala Namu</td>
<td>25 million passengers</td>
<td>New airport, no expansion planned</td>
</tr>
<tr>
<td>Ujung Pandang Hasanuddin</td>
<td>7 million passengers</td>
<td>Expansion project to reach 50 million passengers but date of implementation not known</td>
</tr>
</tbody>
</table>

Table 2: 2014 airport terminal capacity and expansion plans (Source of data from Albatross Airport Database)

This analysis highlights the strong saturation problem at Jakarta Soekarno-Hatta International airport. The terminal expansion, which will increase the airport capacity of 25 million passengers from 2016, will not be sufficient if the airport traffic forecasts are realized.

Figure 3 illustrates the passenger demand traffic to Jakarta Soekarno-Hatta which is forecasted to reach 129 million passengers in 2020, what is 82 million passengers above the maximum airport capacity. This high traffic forecast integrates the fact that the traffic in Indonesia is organized such that almost all passengers enter the country through Jakarta Soekarno-Hatta and are then dispatched to other destinations in the country (especially tourism destinations).
We can imagine that one solution to reduce Soekarno-Hatta congestion would be to have more direct international flights to airports located in final destinations for passengers or to airports that could also play a role of hub.

![Figure 3: Jakarta Soekarno-Hatta international airport (current and potential) passenger traffic and maximum airport terminal capacity (Source of data from Indonesian Civil Aviation and Albatross Airport Database)](image)

Juanda Udara Surabaya (Figure 4) and Ujung Pandang Hasanuddin (Figure 5) airports couldn’t be part of this solution since they would also face saturation problems if traffic forecasts are realized and if they do not expand their terminal capacity by 2020. Both would face a demand of 22 million passengers above their capacity limit.

![Figure 4: Juanda Udara Surabaya international airport](image)

Yearly current and potential passenger traffic and maximum airport terminal capacity (Source of data from Indonesian Civil Aviation and Albatross Airport Database)

Part of the solution could be to divert part of the international traffic from Soekarno-Hatta to the new airport Kuala Namu (which replaces Medan Polonia airport that closed its operations)
in 2013) and to Bali Ngurah Rai airport. Both are international airports that should have available capacity by 2020 (given planned terminal capacity and airport traffic forecasts).

Figure 6 illustrates how a part of the 82 million passengers above the airport capacity limit could be diverted to both these airports that would have then play a role of hub airport to dispatch this traffic to their final Indonesian destination. Given terminal capacity constraints Kuala Namu could welcome 28% of these 70 million passengers (i.e., 23 million passengers) while Bali Ngurah Rai airport 12% of them (i.e., 10 million passengers). In other words, 60% of these 82 million passengers would not be accommodated or would have to be diverted to other Indonesian airports with spare capacity.

Figure 6: Illustration of possible traffic diversion from Jakarta Soekarno-Hatta airport to Bali Ngurah and Kuala Namu airports by 2020 (Source of data from Indonesian Civil Aviation and Albatross Airport Database)

If part of the traffic is diverted to both these airport, the strong position of Indonesian Airlines at these locations (Lion Air and Garuda Indonesia) will allow them to increase their supply from and to these places, as long as their fleet capacity is sufficiently developed. The main risk for these carriers is their inability to develop their activity due to financial limitations (bad economic conditions and management).

The ability to solve part of the congestion problem of Soekarno-Hatta by diverting part of the traffic to other international airports will strongly be linked to the total number of international airports in the country and their spare capacity.

If there are still 5 international airports:

- Airport capacity problems will last, despite the actual plans of expansions,
• The strong position of Indonesian Airlines at these locations (Lion Air and Garuda Indonesia) should allow them to increase their supply from and to these places, as long as their fleet capacity is sufficiently developed,

• Entry of new (foreign) airlines at these airports will be difficult: entry might happen though, in case Indonesian airlines are not capable of operating such an important increase of traffic.

If some current domestic airports reach standards to operate international traffic:

• Entry of new (foreign ASEAN) airlines at these airports is expected,

• Both Low-Cost Carriers and Full Service Carriers will be attracted by the new open routes.

Note that besides investments in airport capacity, other infrastructure investments are needed to handle the additional traffic. In particular, land transportation for connections from international airports to the final destination of the traveler will be a significant part of the whole solution.

3. Conclusion

Our analysis clearly shows that the saturation of the main international airports in Indonesia will lead to a potential loss of air traffic in this country. Soekarno-Hatta airport will lose 49 million passengers by 2020 if the traffic is not diverted to other places. These figures are computed using Indonesian traffic forecast up to 2020. We obtain that 82 Million passengers more are expected at Soekarno-Hatta by 2020. Thirty-three million out of these 82 million passengers can be diverted to other Indonesian international airports which have some spare capacity. However, all the expected traffic will not be handled.

This analysis of the impacts of the air transport liberalization up to the 5th freedom right is essential to go further and identify what could be the impacts of the liberalization up to the 9th freedom right.

The date at which the freedoms up to the ninth freedom right will be given is not yet defined in the ASEAN, and has not been decided by the Member States. Giving all the freedoms to other ASEAN Member States has two main consequences: the first consequence is that ASEAN airlines will be able to operate traffic from any airport of any other ASEAN country, to any destination of ASEAN. The second consequence is that ASEAN airlines will be able to directly target international airports in ASEAN (other than the airports concerned by the MAAS and MALFPAS agreements), which have now reached the safety and technical standards required after the 5th freedom is liberalized.

Anticipating future traffic growth and dealing with potential airport congestion problems are the key issues for ASEAN member states and especially for Indonesia. Due to lack of data, we were not able in this study to deal with issues in runway capacity. An extension of this study would therefore consist of taking into account these issues.
References


