論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Assessment of Airline-Airport Cooperation under Liberalization: A Network Model Approach and Perspectives from Southeast Asia
著者(和文)	SARASWATIBATARI
Author(English)	Batari Saraswati
出典(和文)	学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第9575号, 授与年月日:2014年3月26日, 学位の種別:課程博士, 審査員:花岡　伸也,高田　潤一,屋井　鉄雄,室町　泰徳,福田　大輔
Citation(English)	Degree:Doctor (Academic), Conferring organization: Tokyo Institute of Technology, Report number:甲第9575号, Conferred date:2014/3/26, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Type(English)	Doctoral Thesis

ASSESSMENT OF AIRLINE-AIRPORT COOPERATION UNDER LIBERALIZATION: A NETWORK MODEL APPROACH AND PERSPECTIVES FROM SOUTHEAST ASIA

A Dissertation

Submitted to the Department of International Development Engineering

Graduate School of Science and Engineering of Tokyo Institute of Technology

in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

by

Batari Saraswati

February 2014

ACKNOWLEDGEMENTS

I am deeply indebted to my supervisor Prof. Shinya Hanaoka for his fundamental role in my doctoral work. He provided me with guidance and expertise that I needed during the course of my research.

I would like to acknowledge the thesis committee, Prof. Tetsuo Yai, Prof. Jun-ichi Takada, Prof. Yasunori Muromachi and Prof. Daisuke Fukuda for their valuable comments and suggestions on my research. I would like to extend my appreciation to all professors of the Transport Study Unit and the Department of International Development Engineering for their valuable feedback provided to me during the doctoral seminars and departmental presentations.

I would like to acknowledge researchers in ERIA (Economic Research Institute for ASEAN and East Asia) and officials in INACA (Indonesia National Air Carriers Association) for supporting this research.

I am thankful to the members of the Hanaoka Research Group for their help and company during my study in Tokyo Institute of Technology. I am thankful to friends in Japan, Indonesia, and elsewhere for their support and encouragement throughout.

Above all, I would like to thank my family for their love and support. Without them, this thesis would not have been written. I dedicate this thesis to the memory of my father, whose role in my life was, and remains, immense.

In loving memory of my father, Satriyo bin Soekarno (1955–2012)

Tokyo

February 18, 2014

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A NETWORK MODEL APPROACH AND PERSPECTIVES FROM SOUTHEAST ASIA

Batari Saraswati

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ABSTRACT

This study discussed the issue of airline-airport cooperation. The study modeled airline-airport cooperation utilizing multi-airport multi-airline game theory model. Through the model, the effects of cooperation on the level of competition and social welfare can be systematically assessed based on the extent of network liberalization. Cooperation parties are determined endogenously. Cooperation between airline and airport was found to favor airline dominance that may have negative effect on airline competition. Further, air transport liberalization policy in ASEAN (Association of Southeast Asia Nations) was reviewed and was found that the policy is still limited both in concept and implementation. Finally, real practices of airline-airport cooperation in Southeast Asia were reviewed. It was found that cooperation most likely occurs within country. Airport is cooperating with its dominant local airline in practice, either in form of bilateral incentive scheme for route and traffic development, facility investment, or transit incentive program. The study provides contributions on the development of airline-airport cooperation model and on the overall researches of airline-airport cooperation – providing perspectives from the developing countries.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AEC	ASEAN Economic Community
AEGC	ASEAN Experts Group on Competition
ATRS	Air Transport Research Society
ASA	Air Service Agreement
ASAM	ASEAN Single Aviation Market
ASEAN	Association of Southeast Asia Nations
ASK	Available Seat Kilometer
ATM	ASEAN Transport Ministers' Meetings
BIMP-EAGA	Brunei, Indonesia, Malaysia, Philippines-East ASEAN Growth Area
CAG	Changi Airport Group
CAAV	Civil Aviation Authority of Vietnam
CEAT	Consulting Engineers Association of Thailand
CLMV	Cambodia, Laos, Myanmar, Vietnam
DGCA	Directorate General of Civil Aviation
ERIA	Economic Research Institute for ASEAN and East Asia
EU	European Union
FAA	Federal Aviation Administration
GDP	Gross Domestic Product
HHI	Herfindahl–Hirschman Index
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IDSC	Indonesia Slot Coordinator
IMT-GT	Indonesia, Malaysia, Thailand-Growth Triangle
INACA	Indonesia National Air Carriers Association

IndII	Indonesia Infrastructure Initiative
KPPU	Komisi Pengawas Persaingan Usaha (Commission for the Supervision of Business Competition)
LCC	Low-Cost Carrier
MAAS	Multilateral Agreement on Air Services
MAFLPAS	Multilateral Agreement on the Full Liberalization of Passenger Air Services
MAHB	Malaysia Airport Holdings Berhad
MALPAS	Multilateral Agreement on the Liberalization of Passenger Air Services
MRO	Maintenance, Repair, and Overhaul
NPV	Net Present Value
OAG	Official Airline Guide
OD	Origin Destination
PPNPI	Penyelenggara Pelayanan Navigasi Penerbangan Indonesia (Indonesia Air Service Provider)
RIATS	Roadmap for Integration of Air Travel Sector
SFRB	Special Facility Revenue Bonds
UK	United Kingdom
US	United States
USD	United States Dollar
WEF	World Economic Forum
WTO	World Trade Organization

Chapter 1
Introduction

1.1 BACKGROUND

In the past decades, many restrictive air service bilateral agreements have been replaced by more liberal open skies agreements. Case studies in the past has showed that air transport liberalization have brought significant traffic growth, mainly because liberalization removes constraints on pricing, market access, and allows airlines to optimize their network configuration. Air transport liberalization also benefits the economies by increasing gross domestic product, employment, and tourism. However, despite its benefits, liberalization has also exposed the industry players—especially airlines and airports—to new business risk and uncertainty, due to the shift from regulated into market-like environment. This circumstance has motivated the airlines and airports to form strategic vertical cooperation. Reduction of uncertainty and risk is seen as one of the primary benefits of the formation of airline and airport cooperation.

The effects of vertical cooperation between firms have been studied extensively in the industrial organization and economic literature. However, the effects of vertical cooperation between airlines and airports have received relatively little attention and thus provide room for further examination. Previous studies have suggested that airlines and airports benefit greatly from cooperation, for example, airlines obtain competitive advantage by securing key airport facilities, while airports receive financial support from airlines (Oum and Fu, 2008; Fu et al, 2011). Nevertheless, cooperation between airlines and airports can also raise anti-competitive concern. Close vertical ties between airports and airlines reduce the business risk, but imply a risk of entry by competing airlines more difficult. Cooperation between airline and airport then becomes a subject of increasing debate among practitioners and academics because of its implications for operation levels and for adherence to regulatory requirements in the industry.

Several analytical studies—such as Basso (2008), Barbot (2009, 2011), Fu and Zhang (2010), Zhang et al. (2010), and D'Alfonso and Nastasi (2012)—have examined the effects of airport-airline cooperation on social welfare and the level of competition through a formal model. They show that effects of cooperation differ with the type of contract or agreement, though all of them agree on the fact that airport-airline cooperation is a double-edged sword for downstream airline competition, and the issue requires further examination in order to design a regulatory oversight. Based on this gap in the literature, this study attempts to take into account the context of liberalization in assessing airline-airport cooperation, by utilizing a network approach. Air transport after all is a network industry, and liberalization is expressed in form of air service agreements that govern the network of airlines (Button and Stough, 2000). By utilizing a network approach, assessment of airline-airport cooperation can be carried out based on the extent of network liberalization.

Furthermore, the need to examine the effect of vertical cooperation between airline and airport becomes more crucial, considering liberalization has started to take place in developing countries, such as in Southeast Asia. The governments of Association of Southeast Asia Nations (ASEAN) aim to liberalize air transport service in the region by implementing ASEAN Single Aviation Market by 2015. It has been argued that the challenges of liberalization are greater in developing countries considering several issues such as the lack of sufficient competition policies (Forsyth et al., 2013). Liberalization needs to be consistent with a free and fair competition in order to realize the potential benefits in social welfare and economic growth. As the case of ASEAN countries, the regulatory rules for competition are relatively less developed compared to other countries – as of 2013, only five out of ten ASEAN countries have a full-fledged competition law. This study thus argues that airline-airport cooperation under regional liberalization need to be reviewed from the perspective of fair competition in order to achieve the aim of liberalization itself: to attain competitive international air services that benefit consumers and economic growth in the region.

1.2 RESEARCH OBJECTIVES

The aims of the study are to analyze the effects of airline-airport cooperation on competition level and social welfare, and to evaluate the current practices and policy implications of airline-airport cooperation in Southeast Asia. To achieve the aim, three objectives are drawn as below:

1. To model airline-airport cooperation in order to systematically examine its effect on social welfare and the level of competition. The model should accommodate application involving multi airports, multi airlines and various network settings;
2. To clarify air transport liberalization process in Southeast Asia;
3. To clarify the practices of airline-airport cooperation in Southeast Asia and the policy implications.

1.3 SCOPE AND LIMITATION OF THE STUDY

The model development focuses on airline-airport cooperation in the form of commercial revenue sharing. The findings on the effects of commercial revenue sharing may differ from that of other types of cooperation. Limitations regarding assumptions and applications of commercial revenue sharing model are explained in Chapter three.

This study reviews and analyzes the concept and implementation of air transport liberalization as well as real practices of airline-airport cooperation with respect to air passenger services sector. Air cargo services are not discussed in this study.

This study attempts to do comprehensive review on cooperation practices that entail financial ties between airlines and international airports in Southeast Asia. However, this study only reviews practices that are disclosed and discussed in public; therefore this study does not necessarily cover practices in all ten countries in Southeast Asia. Information on airline-airport cooperation is gathered from primary and a variety of secondary sources such as airport websites, newspaper articles, and reports. Interviews were only able to be conducted with Indonesian airport operator and airline counterparts. The practices discovered in this study can only serve as a lower bound of the actual prevalence of airline-airport cooperation agreements, as the presence of an agreement is often not disclosed officially. Three forms of cooperation are found in Southeast Asia: airport financial incentive scheme on route and traffic development, airline investment on airport facilities, and transit incentive scheme.

1.4 OUTLINES AND APPROACH OF THE STUDY

The dissertation is grouped into six related chapters. The flow and relationship of chapters are provided in Figure 1.1. Chapter one explains the background, objectives, scope, outlines and approach, and contributions of the study. Chapter two provides extended overview on the issue of airline-airport cooperation. Chapter three to five address the three main objectives. Chapter six summarizes the findings of the study. Chapter details follow.

Chapter two reviews the current development of airline-airport cooperation. There are three issues addressed in this chapter: (i) relationship between liberalization and airline-airport cooperation, (ii) definition and forms of cooperation, (iii) existing studies on the effects of airline-airport cooperation. A descriptive approach is used to structure the relationship between liberalization and airline-airport cooperation. This aims to understand how liberalization has helped transforming the traditional relationship between airline and airport into cooperative relationship, based on past experiences such as in North American and European countries. Several forms of airline-airport cooperation are listed based on information retrieved from previous literatures. Existing models and findings on the effects of airline-airport cooperation are also reviewed.

Chapter three develops a mathematical model to systematically analyze the effects airline-airport cooperation on the level of competition and social welfare under commercial revenue sharing agreement. The motivation on choosing commercial revenue sharing as a focus is explained. The merits of the game theory and network approach are explained. The model application and analysis of the results are also provided.

Chapter four analyzes liberalization process in Southeast Asia with respect to air transport industry by reviewing related literatures and conducting interviews. The history and agreements of air transport liberalization in Southeast Asia are explained in details. Moreover, aviation policy and liberalization status in Indonesia are reviewed. The research proponent underwent a three-month internship with Economic Research Institute for ASEAN and East Asia (ERIA) to better understand the framework of ASEAN Single Aviation Market as one of the agendas of ASEAN Economic Community 2015.

Chapter five analyzes the practices of airline-airport cooperation in Southeast Asia. Real practices of airline-airport cooperation are studied by using multiple case studies approach. Factors affecting the prevalence of airport incentive scheme are also analyzed. Finally, policy implications are drawn and competition laws in ASEAN member states are reviewed.

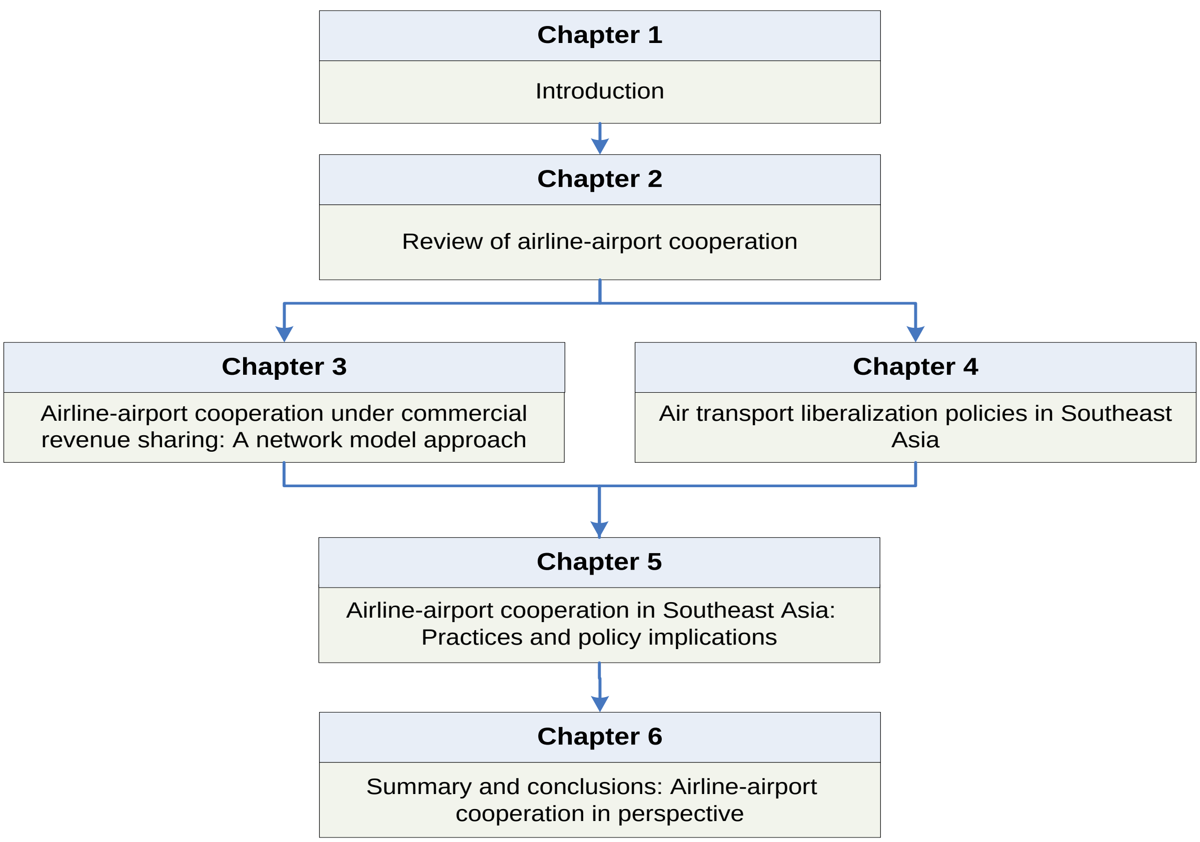


Figure 1.1 Flowchart of chapters

1.5 CONTRIBUTIONS OF THE STUDY

The contributions of the study are argued to be twofold. First, the contribution lays on the approach to examine the effects of airline-airport cooperation. Prior studies examined the effects of airline-airport vertical cooperation utilizing analytical approach. In this study, a two-stage game theory and network approach is utilized. The application of game theory on this study allows us to assess and compare the effects of airline-airport cooperation on the level of competition and social welfare under various network settings, for example in a liberalized network where airlines have greater freedom to expand routes because of more freedom of flights. Furthermore, cooperating parties in the previous analytical studies are predetermined, while in this study cooperating parties are determined by the model as an output.

Secondly, this study investigates liberalization policies and implementation in Southeast Asia as well as reviews the practices of airline-airport cooperation. Therefore, it contributes to the overall researches on airline-airport vertical cooperation – by providing perspectives from the developing countries. This study also raises anti-competition concerns behind practices of airline-airport cooperation in Southeast Asia. This is particularly essential because ASEAN countries are pursuing a more liberal air transport industry.

Chapter 2
Review on Airline-Airport Cooperation

2.1 LIBERALIZATION AND AIRLINE-AIRPORT COOPERATION

Liberalization has changed the landscape of air transport industry from regulated to competitive markets. Starkie (2012) argues that competitive air transport markets drive dynamic efficiency; they are process of discovery, full of surprises and unexpected consequences. One of the consequences is central to the theme of this study – that liberalization has helped transforming the business relationship between airline and airport.

This section explains the concept of air service agreements, impacts of air transport liberalization, and finally structures the mechanism leading to the formation of airline-airport cooperation.

2.1.1 CONCEPT OF LIBERALIZATION (AIR SERVICE AGREEMENTS)

Liberalization generally refers to a relaxation of previous government restrictions. The process of liberalization can be defined as the process of opening market to competition. International air transport has been heavily regulated for economic and social reasons, however over the past decades there has been a global move towards more liberal regime of control (Button and Stough, 2000).

International air transport operates within the framework of the 1944 Chicago Convention, under which airlines commercial rights on international routes are governed by air service agreements (ASAs). ASAs can be enforced between two countries (bilateral) or among several countries (multilateral). The World Trade Organization Secretariat (WTO, 2006) identified seven features of ASAs as relevant indicators of openness for scheduled air passenger services:

1. **Grant of rights** that define air freedoms allowing airlines to provide services over designated market. There are nine freedom of traffic rights (listed in Appendix A), where a restrictive agreement only enforces up to third and fourth freedom and a more liberalized agreement can enforce fifth, seventh and ninth freedom (cabotage);
2. **Capacity clause** that defines regulation on volume of traffic, frequency of services, and aircraft types. Sorted from the most restrictive to the most liberal, three commonly used capacity clauses are: predetermination, Bermuda I, and free determination. Predetermination requires the capacity is agreed prior to the service commencement. Bermuda I gives limited right to the airlines to set their capacities without a prior governmental approval. Free determination finally leaves the capacity determination out of regulatory control;
3. **Tariff approval** that defines whether tariff need to be approved before applied. The most restrictive is that of double approval, whereby both parties have to approve the tariff before this can be applied. The most liberal is free pricing, when tariff are not subject to the approval by any party. The semi-liberal is double disapproval, where all parties have to disapprove the tariffs in order to make them ineffective ;
4. **Withholding** that defines the conditions required for the designated airline. A restrictive agreement requires substantial ownership and effective control, meaning that the designated airline of one country has to be owned and controlled by the nationals of that particular country. A more liberal agreement allows principal place of business condition, meaning that the designated airline of one country can be owned by foreign country.
5. **Designation** that governs the number of airlines allowed to serve the market between countries. A restrictive agreement enforces single designation, where only one airline is allowed to operate from each country. A liberal agreement allows multiple designations.

6. **Statistics** that provides rules on exchange of statistics between countries or their airlines. If exchange of statistics 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.
7. **Cooperative arrangement** that regulates the right for the designated airlines to enter into cooperative marketing agreements (such as code sharing and alliances). This right is considered as a liberal feature because it provides a means to rationalize network.

A liberal (or commonly called "open") air service agreement generally have features that include at least fifth freedom of traffic rights, free determination on capacity, free pricing, principal place of business concept, and multiple designation. The intensity and implementation of liberalization vary from one country to another, depending on many factors such as geographical condition, socio-economic condition, and policy objective (Forsyth et al., 2013). The United States (US) is one of the first governments that pushed for liberalization of international markets. In 1979, the US enacted the International Air Transportation Competition Act which formally laid down the principle of promoting liberalized ASAs with foreign countries. The European Union (EU) countries implemented three air transport liberalization packaged during the period of 1988 to 1997, which eventually created a single aviation market for the EU community carriers in 1997.

2.1.2 Impacts of Liberalization

There have been numerous studies on the economic impacts of air transport liberalization, based on the experience in the US and Europe. The existing studies concluded that liberalization brought significant traffic growth that leads to welfare and economic gains (see for instance IATA, 2007). Removing constraints on pricing, capacity and market access has allowed airlines to compete more effectively and operate more efficiently, which reduces prices and increase service quality and as a result, passenger traffic is stimulated.

The traffic growth leads to additional employments in the aviation sector and in its supply chain. Moreover, it increases catalytic impact in trade and tourism. In addition to that, liberalization also brought some common changes that are summarized into three points as follows:

1. **Network competition**

   Liberalization allows airlines to optimize their network competition. As a result, many major airlines converted from linear point-to-point to hub-and-spoke network (see Figure 2.1). Hub-and-spoke network enables airlines to link small markets with their hub airports, thus increase demand. Furthermore, it allows airlines to take cost advantage (exercising economies of traffic density). The consequence from this phenomenon is the increased airline dominances in their hub airport that deter entry from competitors (Zhang, 1996).

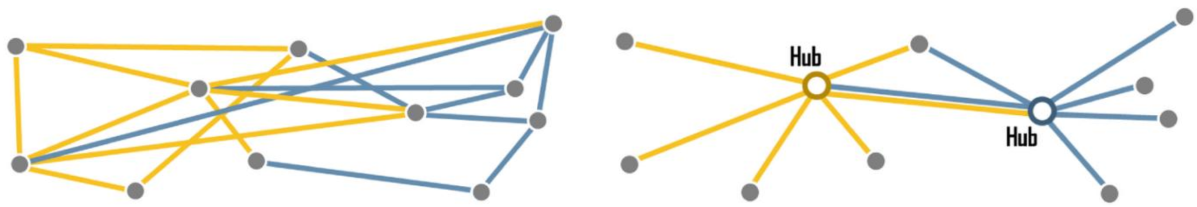


Figure 2.1 Point-to-point vs. hub-and-spoke network

2. **Emergence of low-cost carriers (LCCs)**

   The growth of low-cost carriers was facilitated by liberalization. Fu et al. (2010) argued that there is two-way relationship between low-cost carrier expansion and liberalization. The growth of low-cost carriers leads to increased competition and reduced fare, which stimulate traffic. These changes call for the removal of restrictions on capacity, frequency, pricing. On the other hand, low-cost carriers have benefited from the liberalization by serving fifth and seventh freedom flights and establishing airport bases across borders, as has been evident in EU single aviation market.

3. **Commercialization and privatization of airports**

As a result of loosening government control on air transport, many airports are seen as commercial enterprises rather than public sector utilities. A more commercial approach to airport is deemed necessary to catch up with airline competition (Graham, 2008). Transfer of ownership and management of an airport from government to private sector are expected to bring about improved efficiency, greater competition, and provide greater incentives for management and employees to perform well (Oum et al., 2006). The first major airport privatization took place in the United Kingdom (UK) in 1987. This followed by more privatization (partial or total) in 1997 such as in Düsseldorf, Orlando, Naples, Birmingham, Melbourne, Brisbane and Perth (Graham, 2008).

Despite the positive impacts, liberalization also brings several negative consequences such as airline bankruptcies, merger, acquisition and route rationalization. When restrictions on route entry, capacity and frequency are dropped, barriers to entry into the airlines industry for a new airline decreased significantly, resulting in many airlines entering the market, thus increasing competition. However, as the competition faced by airlines becomes more intense, smaller or low cost effective airlines may be forced to exit the market. For example, from 1993 to 1997 during liberalization in Europe, 88 new airlines are established while 56 airlines suspended their operations (AEA, 1997). In 2001, two national flag carriers, Swissair and Sabena, went bankrupt. Competition also leads to merger and acquisitions among airlines. In US, eight mergers among major airlines were made in 1986 and 1987 after deregulation, such as TWA to American, and Northwest to Delta in 1980s (Borenstein, 1992). Reluctance of some countries to be fully open to liberalization usually comes from a concern that their flag airlines, unsupported by the government, will not be able to compete with larger and more cost-effective airlines.

Liberalization also gives freedom for the airlines to develop or rationalize their routes. As a result, service on essential but uneconomic routes might be lost as airlines turned their focus to profitable routes. Airlines would focus on major trunk routes, leaving regional services underdeveloped. In the case of EU, new carriers have placed much attention on the major trunk routes between Europe's major cities. Essential but uneconomic routes are preserved by using public service obligations and open tendering – a process that allows thin routes to survive but on the basis of fair competition and at the lowest cost possible to the taxpayer (ICAO, 2003).

The positive and negative impacts of liberalization are not uniform across countries; they depend on level of economic development, as well as levels of cost efficiency and productivity of airlines. There has been an increasing number of countries adopted liberalization, and this suggests that countries involved have benefited from liberalization in general (Oum et al., 2009). The negative consequences are expected to be less than the benefits that accrue to the economies in terms of trade, tourism revenues, and employment.

2.1.3 Liberalization Triggers Airline-Airport Cooperation

Several impacts of liberalization—implementation of hub-and-spoke network, emergence of low-cost carriers and privatization of airports—are argued to have triggered the occurrence of airline-airport cooperation. Figure 2.2 shows the connection between liberalization and airline-airport cooperation based on past experiences (Figure 2.2).

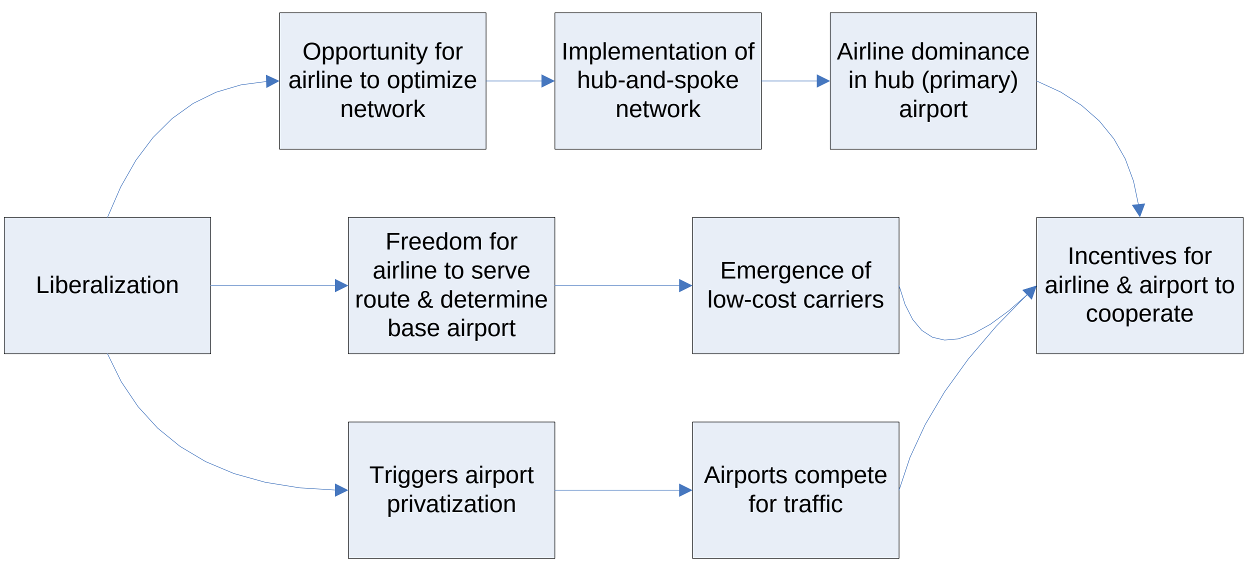


Figure 2.2 Relationship between liberalization and airline-airport cooperation

As mentioned in the previous section, liberalization creates opportunity for airline to optimize network, and as a result many airlines (particularly full-service airlines) implement hub-and-spoke network. Hub-and-spoke network allows airlines to enjoy density economies, where cost per passenger decreases as the number of passengers increases. An important consequence of the emergence of hub-and-spoke networks is the lack of competition between airlines on the hub market and the resulting tendency towards the formation of fortress hubs (Zhang 1996, Pels, 2008). Any airline prefers to have its own exclusive hub rather than to share the same airport with another airline's hub function. This phenomenon is evident especially in US domestic network after deregulation in 1978 (Borenstein, 1989). Airline dominance provides a strong incentive for airports and their respective dominant airlines to cooperate with each other in order to compete successfully with other hub airport-airline combinations in the region.

Furthermore, liberalization also leads to the emergence of low-cost carriers. Low-cost carriers have different business model from that of traditional full-service airlines. As the name suggests, low-cost carriers aim to minimize cost, for example by utilizing a single aircraft type and offering direct routes. In addition to that, low-cost carriers are more free to choose base airport (compared to full-service airlines) since they do not provide connecting flight service. With liberalization, low-cost carriers have more option of base airports as there is freedom to set up base outside origin country. Some have base at hub (primary) airport, but many have base at secondary airports. Secondary airport can be defined as an under-utilized airport that complements a hub airport in a region.

At the same time, more airports are being privatized and they are under growing pressure to be more financially self-sufficient. This is evident particularly in European airports. Under-utilized secondary airports now compete with each other to attract the service of airlines – especially to attract base aircraft from low-cost carriers to utilize the capacity and increase traffic (Starkie, 2012). The increasing competition between airports and increasing bargaining power of low-cost carriers (to move from one base airport to another to find the best financial return) have motivated them to form cooperation.

Based on these evident dynamics, especially in US and Europe, it can be generalized that airline-airport cooperation are occurred between (1) full-service airline and hub airport, (2) low-cost airline and secondary airport. By cooperating with each other, both partners can reduce uncertainty and risk that emerge after liberalization, as also noted by Albers et al. (2005).

2.2 DEFINITION AND SEVERAL FORMS OF AIRLINE-AIRPORT COOPERATION

Traditional economics distinguish horizontal and vertical relationships among firms (Tirole, 1989). The term 'vertical' denotes that the cooperation happen between different stages of production: airport as upstream provider and airline as downstream producer. Airport provides infrastructure and general services to the airlines as its customer. Airport provides aircraft movement facilities including aprons, runways, taxiways, and passenger processing services consisting of aerobridges, baggage systems, check in facilities, public areas in terminals, flight information displays, and landside roads. Airport also supplies non-aeronautical services such as parking, restaurants, administrative office space, and other commercial and retail services. An airline then produces flight services to passengers travelling from one airport to another.

The definition of airline-airport vertical cooperation in this study follows definition in Albers et al. (2005): *a voluntarily formed, contractual collaborative arrangement between airline and airport with the declared intention of reducing risk, improving competitiveness, and thereby enhancing overall performance.* The terms 'airline-airport cooperation' and 'airline-airport vertical cooperation' are used interchangeably in this study.

This section lists several forms of airline-airport cooperation that are evident in many airports, compiled from existing literatures and studies. Majority of the cooperation occur in North American and European airports. The forms of cooperation and their examples are listed as follows.

1. **Airline ownership of airport facilities**

   This is a form of cooperation where airline owns, partially or completely, terminal or other facilities in airport. Such ownership allows the airline to optimize operations of the facilities, while in return it helps airports to finance the development of airport. For example, the development of Terminal 2 of Munich Airport was jointly funded by the airport operating company FMG (60%) and Lufthansa (40%). This form of financial participation entitled Lufthansa to determine matters related to planning and operation of the terminal (Fu et al., 2011). Other example, low-cost carrier JetBlue invested $80 million in Terminal 5 of New York JFK Airport to be used by the airline exclusively under a 30-year lease agreement. JetBlue managed the design and construction of the terminal to suit the branding of the airline (Smyth, 2009).

2. **Signatory airlines of airports**

   When an airline becomes a signatory airline in one airport, it becomes the ultimate guarantors of airport's finances. The signatory airline is responsible to cover the full cost of airport operations required for the airport to break even (Fu et al., 2011). Aeronautical charges are then determined according to the cost remaining after revenue from non-signatory airlines and non-aviation sources has been deducted from the airport's costs. Signatory airlines may end up paying lower charges than non-signatory airlines. Signatory airlines can reduce uncertainty on airport financial and in return, signatory airlines usually enjoy varying degrees of influence over airport planning and operations. Such agreements can be observed in many US airports and in several Australian airports such as Sydney and Melbourne (Barbot, 2009).

3. Long-term facility contract

Long-term contract of airport facilities is a form of cooperation between airline and airport where it gives the partner airline the right to use the airport facilities regardless of usage, and sometimes allow the airline to sublease the facilities to other airlines. Many full-service airlines in the US have long-term contract over airport gates at their hubs (FAA, 1999). For example, US Airways has leased 37 gates at the Charlotte Airport until 2016. At Cincinnati Airport, 50 gates are leased to Delta Airlines and at Minneapolis, 54 gates are leased to Northwest. Some low-cost carriers in Europe have also entered into long-term facility contract with secondary airports. One example is the 10-year facility contract between Durham Tees Valley Airport in the northeast of England and bmibaby, a low-cost subsidiary of British Midland International (Starkie, 2012). With this contract, secondary airport can secure traffic in long run, and in return, airline can have a base that that is generally cheaper and less congested than in primary airport.

4. Airport issuance of revenue bonds to airlines

Many airports in the US issue special facility revenue bonds (SFRB) to airlines to finance development of airport facilities such as maintenance facilities and terminals (Fu et al., 2011). In such arrangements, airports retain ownership of their assets, but transfer the right to their exclusive use to the airline under a long-term lease agreement. For example, Southwest Airlines guarantees the SFRB issues for major modernization project in Dallas Love Field Airport, where Southwest Airlines is the dominant airline in Dallas Airport. With this arrangement, the airport transfers much of the project risk to airline. In return, airline is given preferential or exclusive rights to key airport facilities.

5. **Incentives from airport on route or traffic development**

This is a form of cooperation where airport grants financial incentives to airlines for every new route or additional flights offered. Nowadays, many airports use reductions in the charges (rebates or discounts) as financial incentives for airlines to increase traffic and, particularly, to develop new routes or stimulate additional frequencies. This form of cooperation can be observed not only at small regional airports with low-cost carriers as its main customer but also at many larger airports and even some hub airports. Route development was formerly a sole responsibility of the airlines, but airports increasingly take active role in initiating interest from airlines with more direct route development cooperation. Vienna Airport of Austria is among the first airports that implement the financial incentive program and it claimed many success stories (Auerbach and Koch, 2007). Vienna Airport has positioned itself as a hub between Europe and Eastern countries and it has been granting discount on landing charges for new flights to Eastern Europe or Asia. In addition to that, Vienna Airport also grants incentives for every connecting passenger (see Table 2.1). These incentives allow airport to strengthen its hub position and potentially benefit from increasing passenger throughput.

Table 2.1 Example of incentive scheme on route/traffic development: Vienna Airport

Transfer incentives	Growth Incentives (for routes to Eastern Europe and Intercontinental destination)		
8.21 Euro for each departing passenger (connection within max. 6 hours)	Frequencies Incentives: each additional frequency, added to the existing flight frequencies. Landing charges reduction: - Year 1: 60% - Year 2: 40%	Dense Frequency Incentives: Landing charges reduction: - 7–13 frequencies: 20% - 14–21 frequencies: 30% - > 21 frequencies: 40%	Destination Incentives: routes to new destinations. Landing charge reduction: - Year 1: 80% - Year2: 60% - Year 3: 40%

Source: Vienna Airport website, Auerbach and Koch (2007)

6. **Discount on aeronautical charges (bilateral incentive)**

This is the form of cooperation where airport offer lower aeronautical charges to certain airline, in exchange for the airline's commitment to serve the airport. This has similarity with financial incentives for route/traffic development, in the sense that airport giving discount/rebates on aeronautical charges. However, this form of cooperation usually is subject to negotiation and does not apply to all airlines equally. This practice is often observed between secondary airport and low-cost carrier in Europe. For example, Charleroi Airport in Belgium signed an agreement with Ryanair, offering special conditions for the use of the airports, including reduction in landing charges. Compared to published rates, Ryanair enjoyed a 50% discount in landing fees (European Commission, 2004). On more recent practice, in September 2013, Ryanair and Manchester Airport Group concluded a 10-year growth agreement at London Stansted Airport, which will see Ryanair grow its traffic at Stansted by over 50% from 13.2 million passengers in 2012 to over 20 million, in return for a package of lower costs at Stansted (Ryanair website, 2013). Price discrimination is actually prohibited by the International Air Transport Association (IATA, 1997), airports are required to charge all airlines the same price (or the same discount) for identical services. Therefore, such cooperation is often subject to approval by competition commission.

7. **Revenue sharing between airport and airline**

Revenue sharing is the form of cooperation where airport shares its revenue with certain airlines. Revenue sharing can induce airlines to bring in more passengers to the airport, which in turn can improve the joint profits of airport and airlines. There is a dependency relationship between revenue of airport—both aeronautical (e.g., flight) and commercial services (e.g., shopping concessions, car parking and rental, banking and catering) —and the passenger throughput in the airport. Tampa International Airport, for example, has been sharing 20% of revenue with its signatory airlines since year 2000.

8. Load factor guarantee

Load factor guarantee is the form of cooperation where airport and airline set a target load factor, in exchange for the airline's commitment to serve the airport. Target load factor is set at the start of the period by a contract, and airport agrees to pay (or receive) a contingent payment based on the difference between the realized load factor and the target load factor. When a realized load factor is low at the airport route, the airport pays the compensating money specified in the contract to airline. When, a realized load factor is high the airline pays the 'reward' money to the airport. From the airport's perspective, this contract ensures the airline's commitment to serve the airport, while it is also a tool to share the upside profit in a high load factor situation. From the airline's perspective, this contract serve not only as a risk mitigating tool to compensate for any downside loss of revenue but also as an incentive device, where the desire to avoid a large potential payment encourages the airport's effort, hence overcoming the under-effort problem typically observed after the start of service at an airport. Load factor guarantee mechanism can be observed between Noto Airport, a local airport in Ishikawa Prefecture in the central-northern part of Japan, and Air Nippon Airways group (Hihara, 2012).

The aforementioned forms of cooperation *entail financial ties* between the airports and the airlines. There are other forms of cooperation that do not entail financial ties. Albers et al. (2005) explained three major categories for non-financial cooperation between airports and airlines: capacity-oriented, marketing-oriented, and service-oriented cooperation.

Capacity-oriented cooperation is aimed to maximize the capacity of airport facilities. Examples of capacity-oriented cooperation are common terminal operation (e.g. Terminal 2 Munich Airport) and passenger flow management. Marketing-oriented cooperation mainly focuses on image transfer between airline and airport, for example through co-branding and joint exhibition. Security-oriented are considered important but do not require long-term commitment and are not a strategic nature of airport and airline.

2.3 EXISTING STUDIES ON THE EFFECTS OF AIRLINE-AIRPORT COOPERATION

The effects of vertical cooperation between firms have been studied extensively in the industrial organization and economic literature. However, vertical cooperation between airlines and airports has just started to receive attention in the recent years, most likely due to: (1) price discrimination on aviation services is prohibited by the IATA rules; (2) historical public utility status of most airports has often excluded airports from the lists of anti-trust investigation (Oum and Fu, 2008). Nonetheless, in recent years, airlines and airports have increasingly developed various forms of vertical relations in order to reduce risk and gain competitive advantage over other airlines/airports.

Studies on the effects of airline-airport cooperation can be categorized into two based on the approach used: analytical studies and descriptive studies. Analytical studies use mathematical analytic function (that has closed form solution) to examine the effects of airline-airport cooperation, while descriptive studies employ interviews and case studies. The existing analytical studies are summarized below:

1. Barbot (2006) builds a model to analyze the effects of subsidies, or lower aeronautical chargers for secondary airports on competition between low-cost and full-service airlines. The study uses Ryanair-Charleroi Airport agreement as an example and as a basis of the model. The main findings are that subsidization or lower airport charges benefit consumers and negatively affect incumbent airlines. However, the incumbent airlines may be more affected by the entry of the low-cost carrier rather than by the subsidy.
2. Basso (2008) develops a model of vertical relations between two congestible airports and an airline oligopoly. The study finds that an increased cooperation between airports and all airlines in downstream market can improve congestion level, but the resulting airport pricing strategy leads to a downstream airline cartel. Moreover, when schedule delay costs effects are strong and airline differentiation is weak, it may be optimal, social welfare wise, to have single airline dominating the airport.

3. Barbot (2009) analyzes incentives for vertical cooperation between one airport and one airline that compete with another airport and another airline utilizing three-stage game. In the first stage each pair decides to cooperate or not, in the second stage airports set their prices, and in the third stage, airline competes with each other in prices. The main finding is that incentives for cooperation exist when pairs of airline-airport have different market sizes and/or offer different services (e.g., low-cost airline vs. full-service airline).
4. Fu and Zhang (2010) study the effects of concession revenue sharing between airline and non-congested airport on welfare and level of competition using two-stage game. In the first stage the airport offers airlines the option to share its concession revenue and each airline decides to accept or reject the offer, in the second stage airlines compete in prices. They discuss two cases: a single airport served by (1) a single airline and (2) multiple airlines. In the first case, concession revenue sharing improves welfare as well as the joint profits of airport-airline. In the second case, where only one of the airline shares revenues, the cooperating airline’s profit increases while the outsider’s profit decreases.
5. Zhang et al. (2010) extend the study on concession revenue sharing to multiple airlines and multiple airports, stating that, airport competition would bring about a higher degree of revenue sharing than would single airports. Moreover, they analyze the relationship between the degrees of revenue sharing and how airlines’ services are related to one another (as complements, independent, or substitutes). When airlines provide strongly substitutable services to one another, revenue sharing improves profits but reduces social welfare.
6. Barbot (2011) analyzes the trade-off between competitiveness and welfare in three main types of vertical contracts between airports and airlines: (1) contract in the form of negotiated charges for the use of the airport facilities, (2) long-term leases on terminal, (3) signatory airline status in airport (signatory airline pays the airport the variable costs of its facilities plus a part of the fixed costs). The study uses two-stage game with single airport and multiple airlines. Airlines consists of one leader airline and *n* follower

airlines. The first case exhibits the typical trade-off between competitiveness and welfare; cooperation improves welfare but reduces competition level. The second case only increases consumer surplus and welfare if there are enough improvements in terminal operations by the airlines. The third form of contract is pro-competitive and increases welfare.

7. Hihara (2011) analyzes airport-airline cooperation in load factor guarantee contract under double moral hazard situation (both party make effort but neither can see other's effort). The study uses continuous-time stochastic dynamic programming model and conclude that airport and airline can agree on single optimal load factor contract if the costs of efforts are negligible and risk aversion of both parties is near zero.
8. Hihara (2012) extends the study on load factor guarantee under risk sharing incomplete contract. The study concludes that airline-airport can achieve the first best level of efforts and restore utility losses in the contract. By using numerical examples, the study shows under modest risk aversion, the utility loss is not so severe compared to high risk aversion situation.
9. D'Alfonzo and Nastasi (2012) study vertical cooperation in the context of two competing airports, with one airline leader and (n – 1) airline followers in the downstream market. They utilize multistage facility-rivalry game. They find that the airport and the airline leader (dominant airline) may have incentives to cooperate, however such cooperation may drive the follower airlines out of the market. On the other hand, consumer surplus and welfare is higher when airport and dominant airline cooperate compared to the case in which no cooperation occurs.
10. Barbot et al. (2013) develop a test for vertical cooperation between airports and airlines, based on the evaluation of price-costs margin, in the case of competing and non-competing airports. They empirically test 36 pairs of airport-airline in the case of non-competing airport, and conclude that vertical cooperation is often evident between main national airlines in small airports, and between low-cost carriers in secondary airports.

Table 2.2 Summary of analytical studies on the effects of airline-airport cooperation

Author (year)	Form of cooperation	Model	Number of airlines-airports accommodated
Barbot (2006)	Discount charges	Duopoly game	Two airports, two airlines
Basso (2008)	Merger airline-airport (joint profit)	Oligopoly game	Two airports, multiple airlines
Barbot (2009)	Merger airline-airport (joint profit)	Three-stage game	Two airports, two airlines
Fu and Zhang (2010)	Concession revenue sharing	Two-stage game	First case: one airport, one airline; Second case: one airport, multiple airlines
Zhang et al. (2010)	Concession revenue sharing	Two-stage game	Multiple airports, multiple airlines
Barbot (2011)	Discount charges, Long-term terminal lease, Signatory airline status in airport	Two-stage game	One airport, multiple airlines
Hihara (2011)	Load factor guarantee	Moral hazard dynamic model	One airport, one airline
Hihara (2012)	Load factor guarantee	Incomplete contract	One airport, one airline
D'Alfonzo and Nastasi (2012)	Merger airline-airport firm (joint profit)	Facility rivalry model and two-stage game	Two airports, multiple airlines
Barbot et al. (2013)	Merger airline-airport firm (joint profit)	Two-stage game, empirical analysis	First case: one airport, one airline; Second case: two airport, one airline

Source: author

Meanwhile, descriptive studies employ interview, data elaboration, case studies to examine the effects of airline-airport cooperation. Francis et al. (2003), for example, use case studies to look at the cooperation between low-cost carrier and two European airports. They conclude that cooperation in the form of negotiated charges is not always successful. It has consequences for the airports, the passengers and the relationship between the airport and its incumbent airlines. They find that airport management needs to see both passengers and airlines as customers and to understand the resultant revenue streams before negotiating preferential contract with low-cost carriers.

Fu et al. (2011) examine several forms and effects of vertical cooperation between airlines and airports. They conclude that vertical cooperation enables cooperating parties to achieve various benefits and may be formed as a competitive response to other competing airport-airline alliances, and beneficial effects of vertical cooperation need to be weighed against the negative effects.

Fichert and Klophaus (2011) analyze the effects of financial incentive scheme (discount in aeronautical charges in route and traffic development) in German airports based on publicly available data. They observe no general pattern on the effects of the different incentive schemes on traffic volume, connectivity, and load factors. The study further concludes that discount based on volume and bilateral incentive may favor the largest airline at an airport and raise some competitive concerns.

Starkie (2008) points out that airport-airline contractual development in Europe since liberalization has been focusing on negotiated charges for the use of airport infrastructure. Starkie (2012) extends the analysis and argues that the development of airline business models operating on a pan-European basis and the increasing use of the internet (which has reduced the costs of entry for airlines into local markets) have increased the airports' business risks and increased buyer power of the airlines, that triggers long-term contract. The study questions the need of regulation to oversee airport-airline contract either in the form of sector-specific economic regulation or general competition law.

Chapter 3
Airline-Airport Cooperation Model under Commercial Revenue Sharing: A Network Model Approach

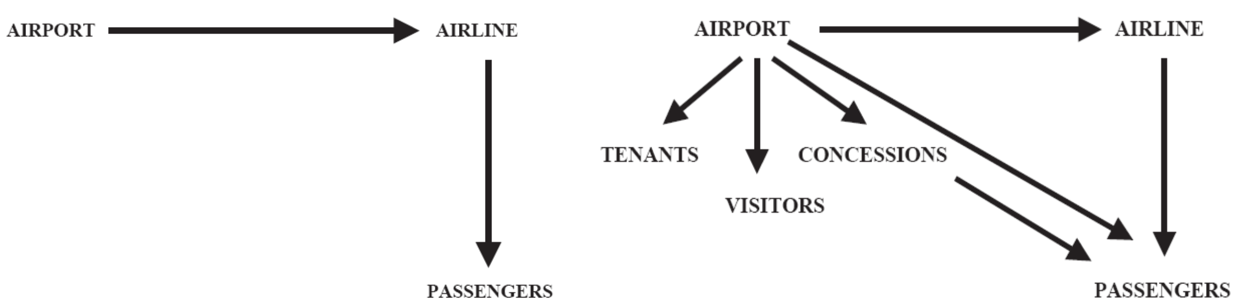
3.1 Introduction

Review on airline-airport cooperation was done in chapter two. Existing studies on the effects of airline-airport cooperation were summarized. The studies show that the effects of cooperation differ with the contract, though all of them agree on the fact that airline-airport cooperation is a potential double-edged sword for downstream airline competition. The issue, therefore, requires further examination. This chapter is constructed to answer the first objective of this study: to model airline-airport cooperation so that the effects of airline-airport cooperation on the level of competition and social welfare can be systematically examined, where the model accommodates application involving multi airports, multi airlines, and various network settings (e.g., liberalized network).

3.2 Commercial Revenue Sharing

The model is developed based on *commercial revenue sharing agreement*. In this form of cooperation, the airport offers to share some part of its commercial revenue for a fixed payment with one or more airlines. Airport revenue is usually classified into two main categories: aeronautical (or aviation) and non-aeronautical (or commercial) revenues (Graham, 2008). Aeronautical revenues are those sources of income which arise directly from the operation of aircraft and the processing of passengers and freight. Commercial revenues are those generated by activities that are not directly related to the operation of aircraft, notably income from commercial activities within terminal and rents for terminal space and airport land, including activities such as running or leasing out shopping concessions of various kinds, car parking and rental, banking and catering, and so on. Since these activities depend greatly on passenger throughput of an airport, there are complementarities between the demand for aviation services and the demand for commercial services.

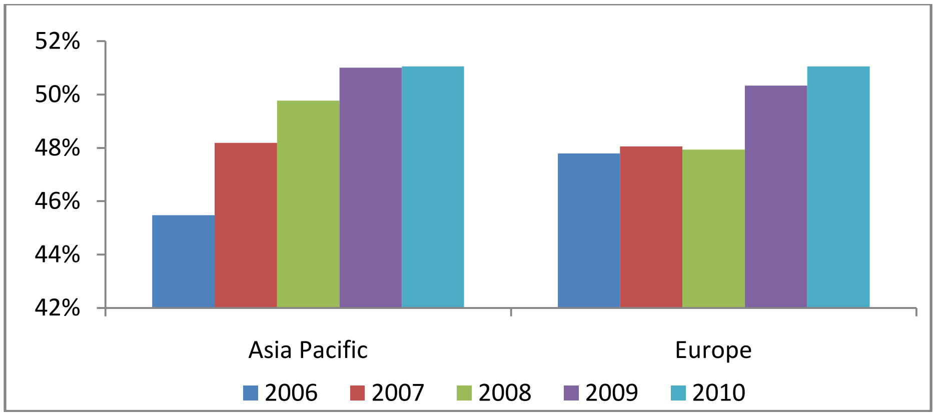
Commercial revenue sharing is chosen as a focus because commercial revenue assumes greater importance these days with airports being increasingly recognized as full-fledged business enterprises. Francis et al. (2004) argue that traditionally airports viewed the airlines as their primary customers, and passengers have only been perceived as part of the airlines business. However, since the mid-1990s, the business approach began to replace the traditional public utility model of airport management, and airports have placed more emphasis on commercial revenues (see Figure 3.1). Trends toward privatization within the industry have given airports greater freedom to develop their commercial strategies. Airport managers are now eager to adopt more creative strategies to exploit all possible revenue generating opportunities. Indeed, commercial operations have been growing relatively faster than aeronautical operations (Jones et al., 1993; Starkie, 2001). There is an increase in contribution of non-aeronautical revenue to total revenue among Asia Pacific and European airports from 2006 to 2010, indicating a growing importance of airport commercial operations (see Figure 3.2). Moreover, commercial operations are usually unregulated, allowing them to be more open to improvement and innovation than aeronautical operations, which are usually subject to various forms of government regulation.



Traditional relationship *Commercial relationship*

Source: Francis et al. (2004)

Figure 3.1 Airport-airline relationships



Source: ATRS Airport Benchmarking Report, 2012
(includes 51 airports in Asia Pacific and 56 in Europe)

Figure 3.2 Average contribution of commercial to total revenue, 2006–2010

In recent years more and more airports started to share revenue with airlines. For example, Tampa International Airport in Florida, United States has been sharing revenue with airlines since 2000. As of 2006, it shared 20% of its net revenue with signatory airlines of the airport. On the airline side, Ryanair, for example, has identified airport car parking as one of its business opportunities and cooperated with the leading airport parking company BCP. In its negotiation with some airports, Ryanair asked for sharing parking revenue as a condition to initiate services at these airports. In other cases, revenue sharing is in effect when airlines hold shares in airports. For example, Terminal 2 of Munich Airport is jointly invested by the airport operating company FMG (60%) and Lufthansa (40%), the airport's dominant airline. Profits generated from the terminal, including those from the lease of areas for catering and retail are shared by FMG company and Lufthansa (Kuchinke and Sickmann, 2005). Some other airline-airport agreements may be broadly classified as revenue sharing, in the sense that airports transfer some benefits to airlines via price discount or favorable usage terms.

Several analytical studies have analyzed the effect of revenue sharing between airline and airport. As explained in chapter two, Fu and Zhang (2010) study the effects of revenue sharing between single non-congested airport and single/multiple airlines on welfare and competition level. Zhang et al. (2010) extend the study to the case of multiple airlines and multiple airports.

3.3 METHODOLOGY: MODELING AIRLINE-AIRPORT COOPERATION IN COMMERCIAL REVENUE SHARING

In order to examine commercial revenue sharing cooperation, a two-stage game model is utilized in this study. The benefit of game theory application in network model is that it allows direct investigation to the effects of cooperation on airlines' operational strategy. It also permits assessment of the outcomes (e.g., profits, consumer surplus, social welfare, and competition level) under different network settings, for example in a liberalized network where airlines have greater freedom to expand routes because of more freedom of flights. Further, the cooperation parties are determined endogenously by the model. Table 3.1 highlights the difference between the proposed model in this study and the other existing airline-airport cooperation models.

Table 3.1 Comparison between proposed and existing model

Author (year)	Model	Number of airports and airlines accommodated	Consider airport capacity	Cooperation parties
Barbot (2006)	Duopoly game	Two airports, two airlines	No	Predetermined
Basso (2008)	Oligopoly game	Two airports, multiple airlines	Yes	Predetermined
Barbot (2009)	Three-stage game	Two airports, two airlines	No	Predetermined
Fu and Zhang (2010)	Two-stage game	First case: one airport, one airline; Second case: one airport, multiple airlines	No	Predetermined
Zhang et al. (2010)	Two-stage game	Multiple airports, multiple airlines	No	Predetermined
Barbot (2011)	Two-stage game	One airport, multiple airlines	No	Predetermined
Hihara (2011)	Moral hazard dynamic model	One airport, one airline	No	Predetermined
Hihara (2012)	Incomplete contract	One airport, one airline	No	Predetermined
D'Alfonzo and Nastasi (2012)	Facility rivalry model and two-stage game	Two airports, multiple airlines	No	Predetermined
Barbot et al. (2013)	Two-stage game, empirical analysis	First case: one airport, one airline; Second case: two airport, one airline	No	Predetermined
Current model	**Two-stage game**	**Multiple airports, multiple airlines**	**Yes**	**Determined by the model**

Source: author

Numerous studies have employed non-cooperative game theory and a network model in order to analyze airline competition, including Hansen (1990), Hong and Harker (1992), Dobson and Lederer (1993), Adler (2001, 2005), Takebayashi and Kanafani (2005), Wei and Hansen (2007), and Li et al. (2010). Hansen (1990) develops a non-cooperative game in which airlines decide on their service frequency by assuming fixed airfares and inelastic demand. He points out the difficulty of obtaining a unique Nash equilibrium solution under homogeneous competition and concludes that a quasi-equilibrium solution exists because of the non-convexity of the game. Airline competition in a network context has also been examined in order to anticipate and analyze the effect of a deregulated market. Adler (2001, 2005) adopts a game theory framework to analyze airline profits based on profit maximization under deregulation and on hub-and-spoke networks. In more recent studies, Li et al. (2010) propose a model for optimizing the allocation of additional routes in a liberalized airline market considering airport capacity constraints.

In this study, a two-stage game is developed to analyze vertical cooperation between airports and airlines. In the first stage, each airport chooses particular airlines with which to cooperate and to share a proportion of its commercial revenue in order to maximize its profit subject to airline acceptance. In the second stage, when an airline receives a revenue share, its operating profit function is affected, which in turn influences its optimal airfare and frequency offered in the downstream market. The final objectives are to observe the revenue sharing allocation that maximizes airport profit subject to airline acceptance and examine the effect of commercial revenue sharing on consumer surplus, social welfare, and competition level.

In Chapter 2, several forms of airline-airport cooperation are identified. Although game-theory network model developed in this study is specified for commercial revenue sharing, the model can be modified to accommodate other forms of cooperation. Cooperation that can be accommodated is the ones where airport transfer some benefits to airlines, such as: (1) airport shares total revenue to airline (modifying r_{in} with respect to total revenue), (2) airport gives discount on aeronautical charges (modifying variables LC_i and PC_i specified per airline), (3) airport incentives on certain route (modifying variables LC_{imk} and PC_{imk} specified per airline and

OD). However, other forms of cooperation such as signatory status of airline in airport, long-term facility contract, airport issuance of revenue bonds to airline, and load factor guarantee require different properties (see Chapter 2 for details) that cannot be accommodated by game theory model presented in this study.

Airline-airport cooperation is modeled based on interactions in the upstream market (between airports and airlines) and the downstream market (between airlines and passengers), as shown in Figure 3.3. The game-theory form is used to model the interactions herein. First, each airport n offers each airline i a proportion of its commercial revenue share (r_{in}) in exchange for a fixed payment. Then, airlines respond to every share offered and compete in the downstream market based on airfare (**p**) and flight frequency (**f**) for their set of ODs and routes $(M, K)_i$. Passengers are accounted for indirectly, and their utility functions are set as the basis for assessing airfare and flight frequency, which in turn determine the market share of the airline. Moreover, an airport chooses the optimal shares and airline partners that can yield the highest benefit (payment) from revenue sharing.

In what follows, the details on model formulation are provided. The model formulation consists of airline network set-up, model assumptions, airline market share estimation, airline profit maximization, airport profit maximization, and solving procedure. All equation notations are listed in nomenclature.

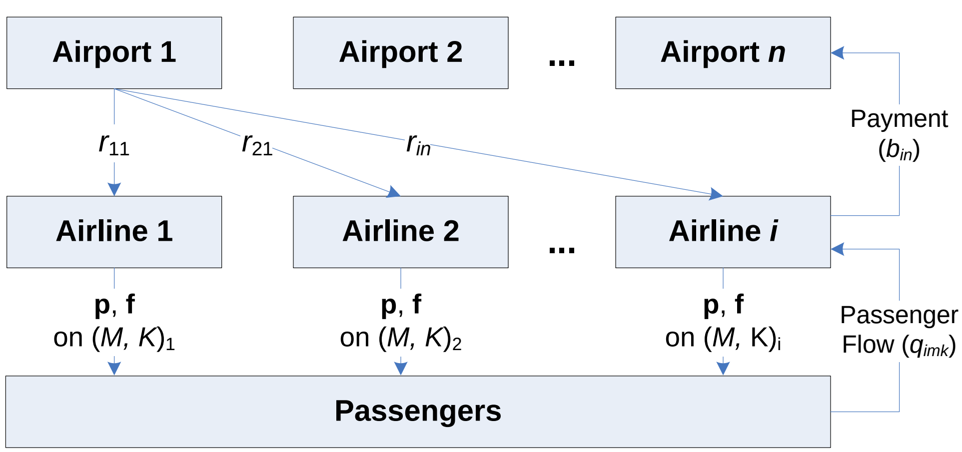


Figure 3.3 Interaction between airports, airlines, and passengers

Nomenclature

I	Set of airlines
N	Set of airports
M	Set of ODs
K	Set of routes serving each OD
q^0_m	Potential passenger demand of OD m (persons)
q_m	Resultant passenger demand of OD m (persons)
φ_m	Expected disutility of OD m ($)
q_{imk}	Passenger flow of airline i of OD m and route k (persons)
u_{imk}	Passenger travel disutility of airline i of OD m and route k ($)
d_{imk}	Schedule delay of airline i of OD m and route k (hours)
t_{imk}	Travel time of airline i of OD m and route k (hours)
tr_{imk}	Transit time of airline i of OD m and route k (hours)
p_{imk}	Airfare of airline i of OD m and route k ($)
f_{ia}	Flight frequency of airline i on arc a (flights/day)
s_{ia}	Aircraft size used by airline i to serve arc a (seats)
c_{ia}	Cost per available seat-km for airline i on arc a ($/km)
q_{ia}	Passenger flow of airline i on arc a (persons)
d_{ia}	Schedule delay of airline i on arc a (hours)
t_{ia}	Travel time of airline i on arc a (hour)s
α	Parameter to convert schedule delay to travel time
α_{vot}	Passenger's value of time ($/hour)
θ	Variation in passenger perception of travel disutility
β	Demand sensitivity to travel disutility
T	Operating hours of airport (hours)
D_a	Flight distance of arc a (kms)
LC_{in}	Landing charge in airport n for airline i ($)
PC_{in}	Passenger charge in airport n for airline i ($)
PCt_{in}	Transit passenger charge in airport n for airline i ($)
λ_{mka}	Equals 1 if arc a is of OD m and route k, otherwise 0
$\lambda_{mkn(o)}$	Equals 1 if airport n is origin airport of OD m and route k, otherwise 0
$\lambda_{mkn(t)}$	Equals 1 if airport n is transit airport of OD m and route k, otherwise 0
$\lambda_{an(o)}$	Equals 1 if airport n is origin airport on arc a, otherwise 0
$\lambda_{an(d)}$	Equals 1 if airport n is destination airport on arc a, otherwise 0
$\mathrm{y}_{n(o)}$	Maximum number of departure flights in airport n (flights)
$\mathrm{y}_{n(d)}$	Maximum number of landing flights in airport n (flights)
π_i	Profit of airline i ($)
Π_n	Profit of airport n ($)
r_{in}	Proportion of airport's n commercial revenue share given to airline i
h_{in}	Commercial revenue per airline's i passenger in airport n ($/passenger)
b_{in}	Payment by airline i to airport n for the r_{in} received ($)
$\mathbf{x}$	Vector of the airfares, flight frequencies, and commercial revenue shares; $\mathbf{x} =(\mathbf{p}, \mathbf{f}, \mathbf{r})$
$\mathbf{r}_i$	Vector of revenue shares of airline i for every airport n; $\mathbf{r}_i = (r_{in}\ \forall\ n)$
$\mathbf{r}_n$	Vector of revenue shares of airport n for every airline i; $\mathbf{r}_n = (r_{in}\ \forall\ i)$
$\mathbf{p}$	Vector of airfares; $\mathbf{p} = (p_{imk})$
$\mathbf{f}$	Vector of flight frequencies; $\mathbf{f} = (f_{ia})$

3.3.1 AIRLINE NETWORK SET-UP

An airline network is illustrated as a directed graph, $G = (N, A)$, where each node (n) represents an airport as an OD point connected to other points by incoming and outgoing arc/flight legs (a). Each airline has a set of ODs and routes $(M, K)_i \subseteq (M, K)$ and flight legs $A_i \subseteq A$ based on the airline's commercial rights (which are governed by air service agreements). A route (k) is defined as an airline's path for serving a particular OD, which consists of one or more flight legs. Airfare is based on OD and route (p_{imk}), while flight frequency is determined by each leg involved (f_{ia}).

Figure 3.4 shows an example of simplified airline networks based on bilateral air service agreements that permit third and fourth freedom flights in Southeast Asia. Three airlines, Garuda Indonesia (GA), Malaysia Airlines (MH), and Thai Airways (TG), offer flights to three international airports. GA, for example, offers direct flights on the Kuala Lumpur (KUL)–Jakarta (CGK) and the CGK–Bangkok (BKK) routes as well as indirect flights on the KUL–BKK route through its hub, CGK. Similar services are offered by MH and TG as well.

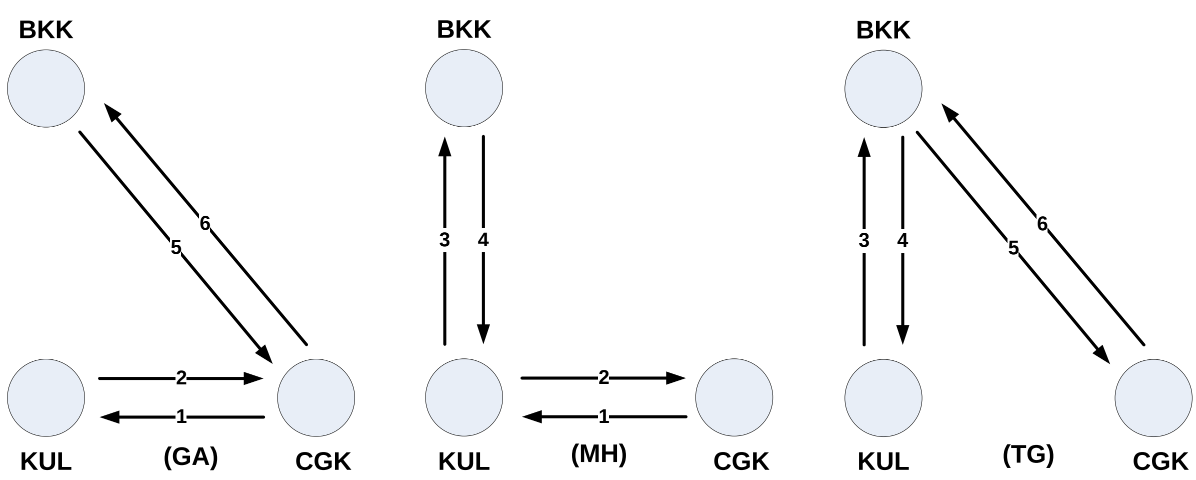


Figure 3.4 Airlines network based on bilateral air service agreements

3.3.2 MODEL ASSUMPTIONS

To facilitate the presentation of the essential ideas without the loss of generality, the following basic assumptions are made in this model. The assumptions are explained in detail in the subsequent sections.

1. The model proposed is intended for strategic planning and/or policy evaluation purposes. Hence, a steady-state (static) model would be appropriate, which has been adopted by many previous related studies (e.g., Adler, 2001, 2005; Hsu and Wen, 2003).
2. The shape of the network is given by scenario. The potential OD demands are predetermined. Interline services between airlines are not available.
3. Airport acts as the decision maker in the cooperation. Airport determines the commercial revenue share allocation to airlines in order to maximize its profit.
4. Airlines maximize their individual profit by competing in airfare and flight frequency. Airline's cost includes aircraft variable cost and additional cost paid to the airports. Meanwhile, airport's marginal operating costs are assumed constant and normalized to zero.
5. Passengers make route choice based on their perception of the disutility or level of services on alternative routes. The disutility of travel on a route is measured by the sum of the line-haul travel time, schedule delay, airfares, and an additional term that captures passenger preferences for travel patterns, i.e., non-stop or one stop. An elastic resultant OD demand function is used to capture the responses of passengers to the level of travel disutility. The responses include the possibility of switching to alternative modes or not to travel at all.
6. Demand for flight service is independent from commercial activities; that is, a consumer with negative surplus from a flight will not make a trip because she derives a positive surplus from commercial services at the airport. Commercial revenue per passenger (h) is predetermined.
7. Social welfare is calculated as the sum of industry (i.e., airline and airport) profit and consumer surplus (based on passenger volume). The consumer surplus derived from commercial activities is not taken into account.

3.3.3 AIRLINE MARKET SHARE

All airlines are assumed to offer homogeneous services and that passengers select their airline and route choices based on their perceptions on the travel disutility of airline routes. For the analysis, a multinomial logit model is used in line with the methodologies of Takebayashi and Kanafani (2005) and Li et al. (2010). The components that define travel disutility (u_{imk}) include basic airfare before taxes and surcharges (p_{imk}), travel time (t_{imk}), scheduled delay time (d_{imk}), and connection time (tr_{imk}), as shown in Equation (3.1). For a direct route, $tr_{imk} = 0$.

The travel time for a route is defined as the sum of travel times for all its arcs (Equation 3.2). Passenger scheduled delay time is defined as the difference between the time at which a passenger desires to travel and the time at which he or she can actually travel on account of inflexibility in the airline's schedule. When flight frequency rises, the gap between the actual and the desired departure time decreases. Schedule delay time can be approximated as a quarter of the average headway (Kanafani and Ghobrial, 1985), as shown in Equation (3.4). Airlines serve certain ODs and routes based on their commercial rights governed by the air service agreement, so that in the equations, $(m, k) \in (M, K)_i$ and $a \in A_i$ apply.

$$u_{imk} = \alpha_{vot}(t_{imk} + \alpha d_{imk} + tr_{imk}) + p_{imk} \tag{3.1}$$

$$t_{imk} = \sum_{a} t_{ia}\lambda_{mka} \tag{3.2}$$

$$d_{imk} = \sum_{a} d_{ia}\lambda_{mka} \tag{3.2}$$

$$d_{ia} = \frac{T}{4f_{ia}} \tag{3.4}$$

An exponential demand function is employed to capture passenger response to airfare and frequency level (Equation 3.5). Potential passenger demand ($q^0{}_m$) represents the number of people that wish to travel from the point of origin to the destination, although they may or may not travel out of disutility (time and monetary cost). The parameter β represents demand sensitivity to the travel disutility of an OD pair. φ_m is expected disutility on route m that is measured by the log-sum formula in Equation 3.6. The parameter θ represents the variation in passenger perceptions of travel disutility. From Equations 3.7 and 3.8, passenger flow on every route (q_{imk}) and on every leg (q_{ia}) for every airline can be obtained.

$$q_m = q^0{}_m \exp(-\beta\varphi_m) \tag{3.5}$$

$$\varphi_m = -\frac{1}{\theta}\left[\ln \sum_i \sum_k \exp(-\theta u_{imk})\right] \tag{3.6}$$

$$q_{imk} = q_m \frac{\exp(-\theta u_{imk})}{\sum_k \sum_i \exp(-\theta u_{imk})} \tag{3.7}$$

$$q_{ia} = \sum_{(m,k)} q_{imk} \lambda_{mka} \tag{3.8}$$

3.3.4 AIRLINE PROFIT MAXIMIZATION

Airlines compete in the downstream market to maximize their profits in response to the commercial revenue share offered by airports. Airline profit is defined as the sum of profits from flight services and profits from commercial revenue sharing with one or more airports. For a given commercial revenue share, the profit of airline *i* is defined in Equation 3.9:

$$\begin{aligned}\pi_i(\mathbf{x}_i, \mathbf{x}_{-i}) = &\sum_{(m,k)} \left[p_{imk} q_{imk} - \sum_n (PC_{in} q_{imk} \lambda_{mkn(o)} + PCt_{in} q_{imk} \lambda_{mkn(t)}) \right] \\ &- \sum_a \left[c_{ia} f_{ia} D_a s_{ia} + \sum_n LC_{in} f_{ia} \lambda_{an(d)} \right] \\ &+ \sum_n \left[r_{in} h_{in} (\sum_i \sum_{(m,k)} q_{imk} \lambda_{mkn}) - b_{in} \right]\end{aligned} \tag{3.9}$$

where $\mathbf{x}_i = (\mathbf{p}_i, \mathbf{f}_i, \mathbf{r}_i)$ is vector of airfare, flight frequency and commercial revenue shares between airline *i* and all airports, and $\mathbf{x}_{-i} = (\mathbf{p}_{-i}, \mathbf{f}_{-i}, \mathbf{r}_{-i})$ is the vector of the other airlines excluding *i*.

The profit generated by a flight service is calculated based on total passenger airfares minus operating costs. Operating costs are estimated based on airline cost per available seat-kilometer on every flight leg (c_{ia}), where D_a and s_{ia} are flight distance and aircraft seat capacity, respectively, on leg *a*. This estimation is based on the generally linear relationship between airline operating costs and distance, as shown by Swan and Adler (2006). Swan and Adler (2006) use an engineering-based function approach to estimate cost per flight in spoke level as a function of flight distance. Through empirical investigation, they find that trip cost is nearly linear in distance across stage lengths. Costs are drawn on internal engineering estimates for Boeing and Airbus designs, which are computed by OPCOST, a Boeing cost model that includes variables such as fuel burn, labor hours, maintenance parts costs, ownership, and insurance costs.

Additional operating costs result from any payments made by airlines in the form of airport landing and passenger charges. Landing charges (*LC*) paid to the arrival airport are based on maximum take-off weight, defined by airline type. Passenger charges (*PC*) are paid to the departure airport. Passenger transfer charges (*PCt*) are paid at subsequent hubs when the passenger is carried on two or more legs. This pricing system, also followed in Adler (2001), is in line with most international airport rules. *PC* and *LC* can be modified to include other relevant charges such as baggage handling and noise charges.

Income from commercial revenue sharing is estimated as commercial share (r_{in}) multiplied by commercial revenue per passenger (h_{in}) and total number of passengers in each partner airport. For every share received, an airline later has to make a fixed payment to the airport (b_{in}). Note that π'_i in Equation 3.10 denotes profit of airline *i* before paying out b_{in} to airport *n*.

$$\pi_i(\mathbf{x}_i, \mathbf{x}_{-i}) = \pi'_i(\mathbf{x}_i, \mathbf{x}_{-i}) - \sum_n b_{in} \tag{3.10}$$

Airlines respond to every commercial revenue share offered by airports and compete in the downstream market by optimizing their own airfare and flight frequency. This is modeled as non-cooperative Cournot–Nash game.

For every commercial revenue share offered by an airport, π'_i are maximized separately and sequentially for every airline. Airline profit maximization is thus formulated as constrained maximization problem:

$$\begin{aligned} \text{Max } \pi'_i(\mathbf{x}_i, \mathbf{x}_{-i}) = & \sum_{(m,k)} \left[p_{imk} q_{imk} - \sum_n (PC_{in} q_{imk} \lambda_{mkn(o)} + PCt_{in} q_{imk} \lambda_{mkn(t)}) \right] \\ & - \sum_a \left[c_{ia} f_{ia} D_a s_{ia} + \sum_n LC_{in} f_{ia} \lambda_{an(d)} \right] \\ & + \sum_n \left[r_{in} h_{in} (\sum_i \sum_{(m,k)} q_{imk} \lambda_{mkn}) \right], \quad \forall i \end{aligned} \tag{3.11}$$

subject to:

$$q_{ia} \leq s_{ia} f_{ia}, \quad \forall\, a, i \tag{3.12}$$

$$\sum_i \sum_a f_{ia} \lambda_{an(d)} \leq y_{n(d)}, \quad \forall\, n \tag{3.13}$$

$$\sum_i \sum_a f_{ia} \lambda_{an(o)} \leq y_{n(o)}, \quad \forall\, n \tag{3.14}$$

The first constraint in Equation 3.12 ensures that the passenger flow on every leg is less than the total seat capacity offered. The second and third constraints in Equations 3.13 and 3.14 ensure that the total number of arrivals/departures do not exceed the available quota of the destination/origin airports.

3.3.5 Airport Profit Maximization

Each airport determines the commercial revenue share allocation to airlines in order to maximize profit. Airport's marginal operating costs are assumed constant and normalized to zero. The same assumption is also utilized in Basso and Zhang (2010). Operating costs per passenger vary widely among airports based on fluctuations in personnel/crew costs, maintenance costs, and other costs. Consequently, the airport's profit equals its total revenue, as shown in Equation

3.15. Three components comprise airport profit: aeronautical revenue, residual commercial revenue, and the payments collected from airlines.

$$\Pi_n = \sum_i \left[\sum_a LC_{in} f_{ia} \lambda_{an(d)} + \sum_{(m,k)} PC_{in} q_{imk} \lambda_{mkn(o)} + \sum_{(m,k)} PCt_{in} q_{imk} \lambda_{mkn(t)} \right] + (1 - \sum_i r_{in})(\sum_i \sum_{(m,k)} q_{imk} \lambda_{mkn} h_{in}) + \sum_i b_{in} \qquad (3.15)$$

LC is landing charge per flight, *PC* is departure passenger charge, and *PCt* is transit passenger charge. Commercial revenue is estimated as commercial revenue per passenger (h_{in}) multiplied by total number of passengers in the airport. Commercial revenue per passenger is specified per airline; certain airline passengers may spend more in the airport than other airline passengers do (Saraswati and Hanaoka, 2012; Francis et al., 2003).

Note again that under such a commercial revenue sharing arrangement, an airport shares a proportion of its commercial revenue (r_{in}) with an airline in return for a payment (b_{in}). Hence, if r_{in} = 0, then b_{in} = 0. Since airports seek to cooperate with airlines that can provide them with the highest benefit, it can be assumed that an airport will charge the maximum payment to an airline. This payment is thus fixed at the level at which the airline is indifferent between accepting and not accepting the commercial revenue share (the same assumption is employed in the analytical model presented by Zhang et al., 2010), so that

$$b_{in} = \pi'_i(\mathbf{x}_i, \mathbf{x}_{-i}) - \pi^0{}_i(\mathbf{x}_i, \mathbf{x}_{-i}) \qquad (3.16)$$

π'_i is the profit generated by airline *i* under a commercial revenue sharing agreement before paying b_{in}, whereas π^0_i is the profit generated by airline *i* in the initial state when it is not operating under a commercial revenue sharing agreement, with $\mathbf{x}_i = (\mathbf{r}_i = 0, \mathbf{p}_i, \mathbf{f}_i)$ and $\mathbf{x}_{-i} = (\mathbf{r}_{-i} = 0, \mathbf{p}_{-i}, \mathbf{f}_{-i})$. The right-hand side term in Equation (3.16) thus represents the benefit airline *i* derives because of the existence of a revenue sharing agreement with airport *n*.

Under this formulation, airport n determines the commercial revenue share to be allocated to the airlines in order to maximize its profit, subject to airline acceptance. Therefore, the profit maximization problem is formulated as a constrained maximization problem:

$$\text{Max } \Pi_n(\mathbf{r}_n, \mathbf{r}_{-n}) \quad \forall\, n \tag{3.17}$$

subject to:

$$0 \le r_{in} \le 1 \quad \forall\, i, n \tag{3.18}$$

$$\sum_i r_{in} \le 1 \quad \forall\, n \tag{3.19}$$

where $\mathbf{r}_n$ is a vector of the commercial revenue shares between airport n and all airlines and $\mathbf{r}_{-n}$ is a vector of the commercial revenue shares of the other airports excluding n. Each airport maximizes its profit separately and sequentially under the following two constraints: an airline can receive a maximum commercial revenue share of 100% from every airport (Equation 3.18) and total commercial revenue share in every airport is 100% (Equation 3.19).

Since an airport is assumed to charge the maximum possible payment to airlines, all the benefit of revenue sharing by the airline (b_{in}) will flow to the airport and thus the airline bares no loss but makes no profit. This assumption is utilized in the formulation in order that an airport can find a partner airline and agree a commercial revenue share that brings about the highest benefit. In reality, however, airline is unlikely to enter into such an agreement. Once an airport knows with which airline to cooperate and the optimal commercial revenue share to be collected, the total system benefit from revenue sharing can be re-distributed to each party. Total system benefit in this regard can be defined as the difference between total profits of cooperating parties before and after entering into the commercial revenue sharing agreement, and it can be redistributed equally or unequally according to bargaining/negotiation power of each party.

The distribution of total system benefit derived from such cooperation is typically determined based on bargaining power of each party. Several studies have discussed the issue of airline-airport bargaining power in details. Starkie (2012), for example, argues that air transport liberalization and Internet booking systems have increased the bargaining power of airlines (particularly low-cost airlines) compared with airports. However, the distribution of the total system benefit is not the focus of this model.

Furthermore, consumer surplus and social welfare can be estimated in order to examine the effect of airport-airline revenue sharing. Social welfare is defined in terms of total airport profit, airline profit, and consumer surplus. From microeconomic theory, consumer surplus can be defined as the monetary gain obtained by consumers because they are able to purchase a product for a price that is less than the highest price that they would be willing to pay (Varian, 1996).

$CS = \int_{p}^{p_{\max}} q(p)dp$, where $q(p_{\max}) = 0$.

Consumer surplus in the passenger demand model is defined by following this notion, where price is equivalent with expected monetary value of generalized travel cost (Equation 3.6), so that:

$CS_m = \int_{\varphi_m}^{\varphi_{m(\max)}} q_m d\varphi_m$, where $q(\varphi_{m\,max}) = 0$.

$$CS_m = \int_{\varphi_m}^{\varphi_{m(\max)}} q^0{}_m \exp(-\beta\varphi_m)d\varphi_m$$

$$CS_m = -\frac{q^0{}_m}{-\beta}\exp(-\beta\varphi_m)$$

$CS_m = \frac{q_m}{\beta}$, and therefore for consumer surplus for all ODs: $CS = \sum_m \frac{q_m}{\beta}$.

Social welfare as the sum of total airport profit, airline profit, and consumer surplus can be defined as in Equation 3.20.

$$SW = \sum_n \Pi_n + \sum_i \pi_i + \sum_m \frac{q_m}{\beta} \tag{3.20}$$

3.3.6 SOLVING PROCEDURE

In summary, the basic idea herein is to solve commercial revenue share allocation problem that maximizes each airport's profit, subject to airline acceptance. Revenue sharing by an airport affects airline's profit function, which in turn influences the airfares and flight frequencies that determine passenger flow. Passenger flow in turn determines airline profit and payment collected from the airline in return for that particular revenue share, and thereby determines airport profit. The interconnection between variables can be seen in Figure 3.5.

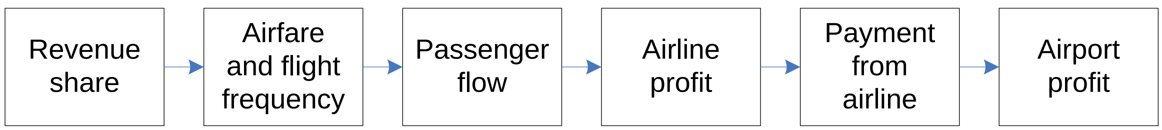


Figure 3.5 Interconnection between variables

Considering the straightforward interconnection between one variable to another, a straightforward algorithm is sufficient to solve the revenue share allocation problem. First, the constrained maximization problem in Equations 3.17–3.19 is transformed into an unconstrained maximization by using the penalty approach as follows:

$$Z_n(\mathbf{r}_n, c_j) = \Pi_n(\mathbf{r}_n, \mathbf{r}_{-n}) - c_j\left(\sum_i (\max^2\{0, r_{in} - 1\}) + \max^2\{0, (\sum_i r_{in}) - 1\}\right). \tag{3.21}$$

The first term in Equation (3.21) is the airport's profit (Equation 3.15), the second term is the penalty function for the first constraint (Equation 3.18), and the third term is the penalty function for the second constraint (Equation 3.19). c_j is a penalty parameter. Here, each unsatisfied constraint influences $\mathbf{r}_n$ by assessing a penalty equal to the square of the violation. If the value of c_j is suitably large, the penalty term will represent a heavy cost for any constraint violation; therefore, the maximization of the augmented objective function will avoid a penalty, thereby yielding a feasible solution.

We start with the initial value of $\mathbf{r}_n$ that violates at least one of the constraints and that increases the value of the penalty parameter c_j until the maximum value that satisfies all constraints is found. However, by only using these criteria, we may be left with a suboptimal solution, because an $\mathbf{r}_n$ satisfies the constraints shown in Equations. (3.18) and (3.19) but it does not provide the optimal value of Equation (3.21).

Based on the foregoing, the sequential unconstrained optimization technique (see Fiacco and McCormick, 1968) is used in order to solve the augmented objective function and then additional stopping criteria that can guarantee the derivation of the optimal value is introduced. The following three-step procedure (initialization step, iterative step, and stopping rule) is therefore run for each airport sequentially.

1. ***Initialization step***: Select an airport in the sequence. Set initial revenue shares for all airports, choosing $\mathbf{r}_n$ for the airport in the sequence that violates at least one constraint and setting $\mathbf{r}_{-n} = 0$ for the other airports that do not share the revenue. Select initial airfares $\mathbf{p}$ and flight frequencies $\mathbf{f}$ for all airlines. Select an initial value for the penalty parameter. Let $j = 1$. We introduce parameter z^{opt} to ensure the optimality of the objective function so that pre-mature convergence (i.e., suboptimal solution) can be avoided. Set $z^{opt}_{(j=1)} = 0$ as the first quest of the maximization problem which is then compared with the value of the augmented objective function.

2. ***Iterative step***: Maximize Equation (3.21) by the Hooke-Jeeves pattern search technique (Hooke and Jeeves, 1961). For every $\mathbf{r}_n$ in an exploratory move, run the airline profit maximization procedure in order to obtain the corresponding passenger flow (Equation 3.7) and airline payment (Equation 3.16), and thereby airport profit (Equation 3.21). Airline profit maximization procedure in Li et al. (2010) is followed, where:

   - The constrained airline maximization problem in Equations (3.11)–(3.14) is transformed into unconstrained problem utilizing a Lagrangian relaxation approach. The augmented Lagrangian function for airline i is shown below, where ρ is the penalty constant, and τ_{ia}, $\xi_{n(d)}$, $\eta_{n(o)}$ are the Lagrange multipliers.

$$
\begin{aligned}
L_i(\mathbf{x}_i, \boldsymbol{\tau}, \boldsymbol{\xi}, \boldsymbol{\eta}) &= \pi_i(\mathbf{x}_i, \mathbf{x}_{-i}) - \frac{1}{2\rho}\{\sum_a (\max{}^2\{0, \tau_{ia} + \rho(q_{ia} - s_{ia} f_{ia})\} - (\tau_{ia})^2) \\
&+ \sum_{n(d)\in N} (\max{}^2\{0, \xi_{n(d)} + \rho(\sum_i \sum_a f_{ia}\sigma_{an(d)} - y_{n(d)})\} - (\xi_{n(d)})^2) \\
&+ \sum_{n(o)\in N} (\max{}^2\{0, \eta_{n(o)} + \rho(\sum_i \sum_a f_{ia}\sigma_{an(o)} - y_{n(o)})\} - (\eta_{n(o)})^2)\}
\end{aligned} \tag{3.22}
$$

- The maximization problem of unconstrained function in Equation (3.22) is solved separately and sequentially for every airline. A Hooke-Jeeves method is then used to find the equilibrium solutions for airfare and flight frequencies. A specific sequence of airlines is chosen and the mathematical program is solved for the first airline in the sequence. Once an optimal solution is found, given all other airlines' decision variables, the mathematical program is then solved for the second airline, and so on.
- If the constraints in Equations (3.12)–(3.14) are satisfied, obtain the optimal solution; otherwise, the Lagrange multipliers are updated. The Lagrange multipliers are updated for *e* iteration by:

$$\tau_{ia}{}^{(e+1)} = \max\{0, \tau_{ia}{}^{(e)} + \rho^{(e)}(q_{ia}{}^{(e)} - s_{ia} f_{ia}{}^{(e)})\}, \quad \forall a, i \tag{3.23}$$

$$\varepsilon_{n(d)}{}^{(e+1)} = \max\{0, \varepsilon_{n(d)}{}^{(e)} + \rho^{(e)}(\sum_i \sum_a f_{ia}{}^{(e)}\sigma_{an(d)}{}^{(e)} - y_{n(d)}{}^{(e)})\}, \quad \forall n \tag{3.24}$$

$$\eta_{n(o)}{}^{(e+1)} = \max\{0, \eta_{n(o)}{}^{(e)} + \rho^{(e)}(\sum_i \sum_a f_{ia}{}^{(e)}\sigma_{an(o)}{}^{(e)} - y_{n(o)}{}^{(e)})\}, \quad \forall n \tag{3. 25}$$

- For a Nash equilibrium to exist, there are several conditions: (i) the strategy profile of each player is bounded, convex, and closed, (ii) the pay-off function for each player is concave with respect to the player's strategy assuming fixed competitor strategies, and (iii) all pay-off functions are continuous over the strategy sets of all players (Adler, 2005). The airline strategies in this case are bounded, convex, and closed; moreover, the airline profit function is continuous. However, airline profit function is not concave since passenger flow q_{imk} is defined by an exponential demand function (Equation 3.7). Thus, a

Nash equilibrium in airline profit maximization does not necessarily exist; even if it does exist, it cannot be guarantee that it is unique.

Find the revenue share $\mathbf{r}_n$ that maximizes Equation (3.21) of airport n. Call it $\mathbf{r}_{n(j)}$ and check if all constraints are satisfied.

3. ***Stopping rule***: If the constraints in Equations (3.18) or (3.19) are not satisfied, set $c_{j+1} = \gamma c_j$ and back to the iterative step, where γ is a parameter to increase the value of c_j; otherwise, set $c_{j+1} = c_j$. Then, check the value of the objective function:

- If $z^{opt}_{(j)} < Z(\mathbf{r}_n, c_j)$, set $z^{opt}(j+1) = Z(\mathbf{r}_n, c_j)$, return to iterative step with starting point $\mathbf{r}_{n(j+1)} = \mathbf{r}_{n(j)} + \Delta\mathbf{r}_n$. Set $j = j+1$.
- If $z^{opt}_{(j)} > Z(\mathbf{r}_n, c_j)$, return to iterative step with point $\mathbf{r}_{n(j+1)} = \mathbf{r}_{n(j)} + \Delta\mathbf{r}_n$. Set $j = j+1$.

If all constraints are satisfied and $z^{opt}_{(j)} - Z(\mathbf{r}_n, c_j) = 0$, stop with $\mathbf{r}_{n(j)}$ an estimate of the optimal solution.

The result of the revenue share allocation of the airport in the current sequence becomes the input of $\mathbf{r}_{-n}$ in the next sequence, and so on. Finally, select the next airport in the sequence until the revenue shares of all airports have been decided. In the numerical example $\gamma = 10$, initial c_j = 500,000, and $\Delta\mathbf{r}_n = (0.01\ \forall\ i, n)$ are used.

Game theory suggests that different equilibrium solutions may be attained according to initial solution value (Hansen, 1990; Adler 2001; Adler 2005). However, the effects of revenue sharing on profit of airline and airport remain the same regardless of the initial solution. Plots of airline profit, airport profit, and social welfare, with respect to revenue share, for different initial solutions are shown in Appendix B.

The proposed solution algorithm is presented in Figure 3.6. The algorithm was coded in programming language Java and run in Eclipse on a personal desktop computer with an Intel Core Duo 3-GHz CPU 4GB RAM. The computation time for revenue share allocation of every airport takes 15.3 minutes. In network with three airports and three airlines, the total computation time takes about 46 minutes. Increase in number of airport and airline may increase the computation time significantly due to the total number of OD and routes involved.

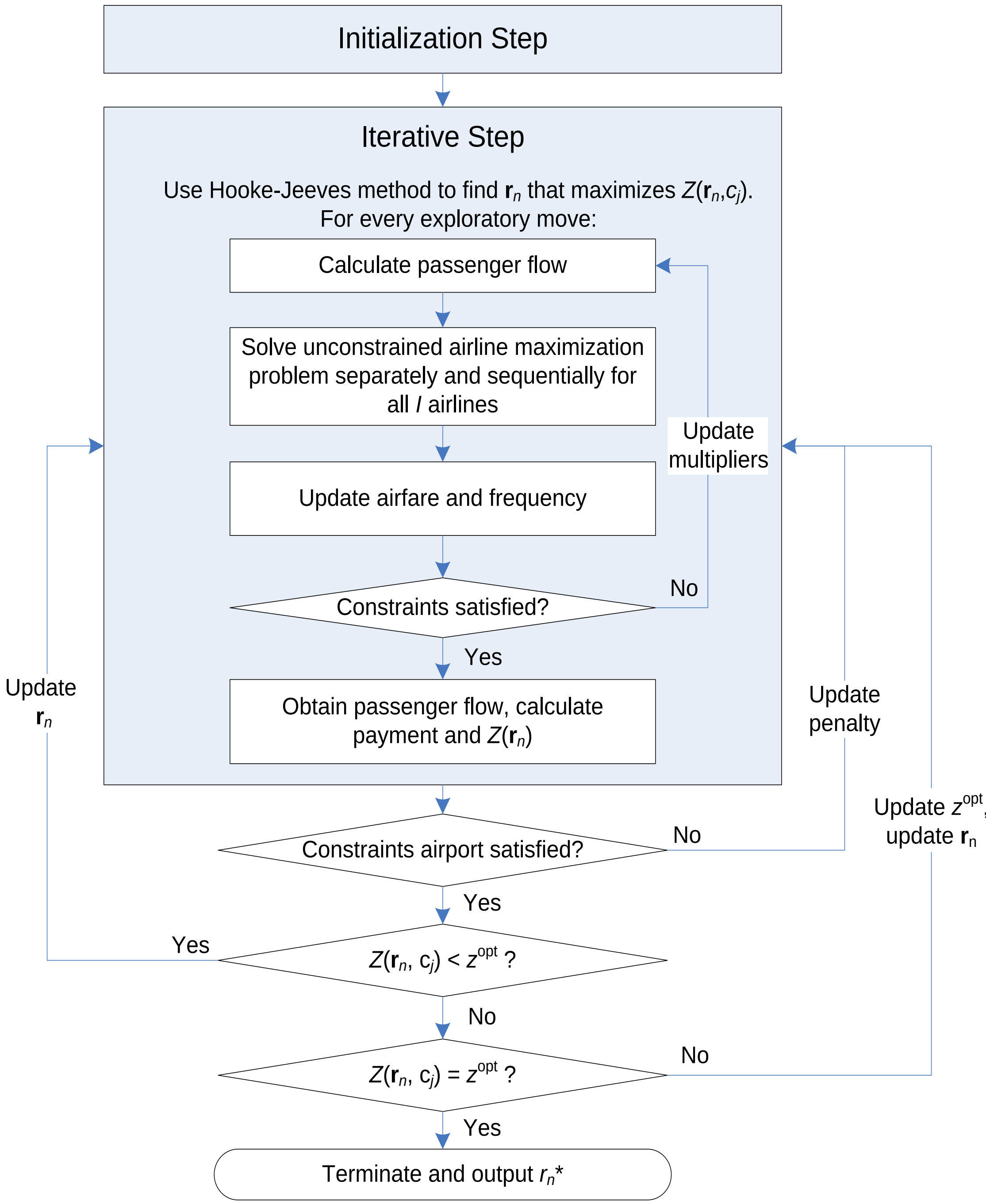


Figure 3.6 Solution algorithm for every airport

3.4 MODEL AND ANALYSIS

3.4.1 MODEL

To illustrate the model concepts, a numerical example by using a simplified network with three airlines and three airports in Southeast Asia (see Figure 3.4) is presented. All input parameters are based on real market data, wherever possible. Cost per available seat-kilometer for all airlines is $0.08 (the actual cost per available seat-kilometer of airlines GA, MH, and TG are 7.61 cents or $0.076, 0.248 ringgit or $0.081, and 2.575 baht or $0.084, respectively, as listed in each airline's annual reports of 2011). The landing charges for international flights in airports CGK, KUL and BKK are provided in Table 3.2. Landing charges and passenger charges are regulated by governments. Flight distances for CGK–KUL, KUL–BKK, and BKK–CGK are 1125, 1214, and 2286 km, respectively, while flight durations are 2, 2, and 3.4 hrs, respectively. Further, although real-life airlines may utilize more than one type of aircraft, we assume that all airlines use narrow-body aircrafts with 170 passenger seats.

Potential demand between OD pairs is assumed 3000 passengers/day, one-way. In reality, though, potential demand differs from one OD pair to another. Potential demand of 3000 passengers/day is a rough approximation from the annual traffic data on KUL to CGK journeys (2.944 million passengers in 2011). Other input parameters are obtained from earlier studies: α_{vot} = $20.5/hour and α = 1.3 (Hsu and Wen, 2003); θ = 0.02 (Takebayashi and Kanafani, 2005); β = 0.003 (Li et al., 2007), and T = 18 hours. Table 3.3 presents the initial airfare and flight frequency obtained from airlines' website.

Table 3.2 Aeronautical charges for international flights in airports CGK, KUL, BKK

Charges	CGK	KUL	BKK
Landing charges for narrow body aircraft (per flight)	$397.96	$229.28	$412.64
Passenger charges (per passenger)	$15	$20	$22
Transit passenger charges (per passenger)	$11	$16	$18

Source: airport's website

Table 3.3 Airlines initial airfares and flight frequencies

O-D (m)	One-way airfare (p_{imk}) USD $			Daily frequency (f_{ia})		
	GA	MH	TG	GA	MH	TG
CGK - KUL	84	84	372 (indirect)	3	6	-
KUL - CGK	84	84	372 (indirect)	3	6	-
KUL - BKK	273 (indirect)	90	90	-	4	3
BKK - KUL	273 (indirect)	90	90	-	4	3
BKK - CGK	190	190 (indirect)	190	2	-	2
CGK - BKK	190	190 (indirect)	190	2	-	2

Source: airline's website (obtained in 2012)

3.4.2 ANALYSIS OF THE RESULTS

Several noteworthy results and findings are explained as follows.

1. Airline and airport profits

Commercial revenue sharing may increase airport-airline profit because of the internalization of demand complementarities between flight revenue and commercial consumption for airline. Essentially, commercial revenue sharing increases an airline's marginal revenue and, therefore, encourages the airline to fly more passengers to/from the partner airport.

First, the numerical result in the case of revenue sharing between one airport and one airline (airport and airline are predetermined) is examined. In Table 3.4 and Figures 3.7–3.10, the results in the case of KUL sharing commercial revenue exclusively with MH are provided. It is found that an increase in the share of commercial revenue (r) and commercial revenue per passenger (h) strictly increases airline profit before payment (π'). Commercial revenue includes concession, catering, land, and parking revenue. There are large variations among airports with respect to their commercial revenue per passenger (*h*), and in this case study, h = \$20 for all airports and airlines is used. The highest commercial revenue per passenger among Asia-Pacific airports in 2010 was found at Kansai International Airport (27\$; ATRS, 2012), *h* approximately \$20 is considered to be an acceptable measure. It should be noted that commercial revenue per passenger (*h*) is predetermined in this model. In reality, however, commercial activities in airport are potentially affected by the presence of revenue sharing agreements. Revenue sharing agreement can potentially increase consumer consumption per passenger at airports.

Figure 3.7 shows the profit of MH. An increase in airline profit is owing to the increase in number of passengers, which itself is caused by a decreasing airfare (see Table 3.4). Plots of airfare-revenue share per flight leg for all three airlines are provided in the Appendix. Moreover, an increase in revenue share increases the profit of cooperating MH, but reduces the profits of the outsider airlines (GA and TG), as shown in Figure 3.8. Fu and Zhang (2010) obtained similar results. They found that revenue sharing between one airline and one airport supports the cooperating airline to expand output, which in turn improves the airline profit and benefit travelers, however it potentially disadvantages other airlines.

The cooperating airline later must pay the airport for the revenue share received. As noted in the previous section, three components comprise airport profit: aeronautical revenue, residual commercial revenue, and the payment collected from airline. An increase in revenue share *r* increases payment from airline and slightly increases aeronautical revenue because of the increasing number of passengers, but it also reduces residual commercial revenue, as shown in Figure 3.9. Therefore, airport profit with respect to *r* is not strictly increasing due to the effect of the increasing payment, and decreasing commercial revenue. Figure 3.10 shows profit of KUL.

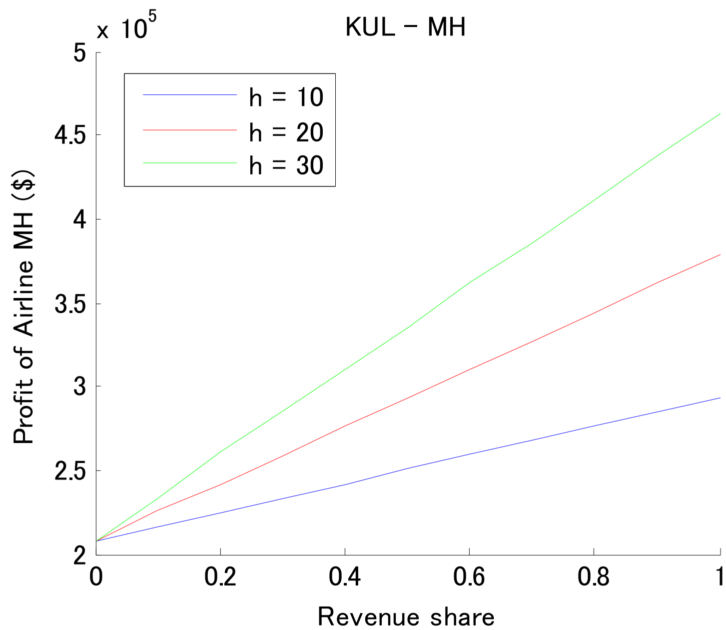


Figure 3.7 An increase in *r* and *h* increases the profit (π') of the cooperating airline

Table 3.4 Airfare and total passenger of MH when KUL shares revenue with MH

$r_{\text{MH-KUL}}$	Airfare one-way $ (p)			Total number of passengers (q_{MH})
	CGK–KUL	KUL–BKK	BKK–CGK (indirect)	
0	119.26	126.25	180.47	4,470
0.1	119.18	126.17	180.21	4,474
0.2	119.09	126.09	178.96	4,489
0.3	118.85	126.09	177.29	4,552
0.4	118.74	125.57	176.56	4,574
0.5	118.56	125.36	176.30	4,585
0.6	118.21	124.89	175.57	4,597
0.7	117.92	124.79	174.64	4,625
0.8	117.70	124.27	173.18	4,677
0.9	117.44	124.27	170.94	4,689
1	117.23	124.27	170.78	4,729

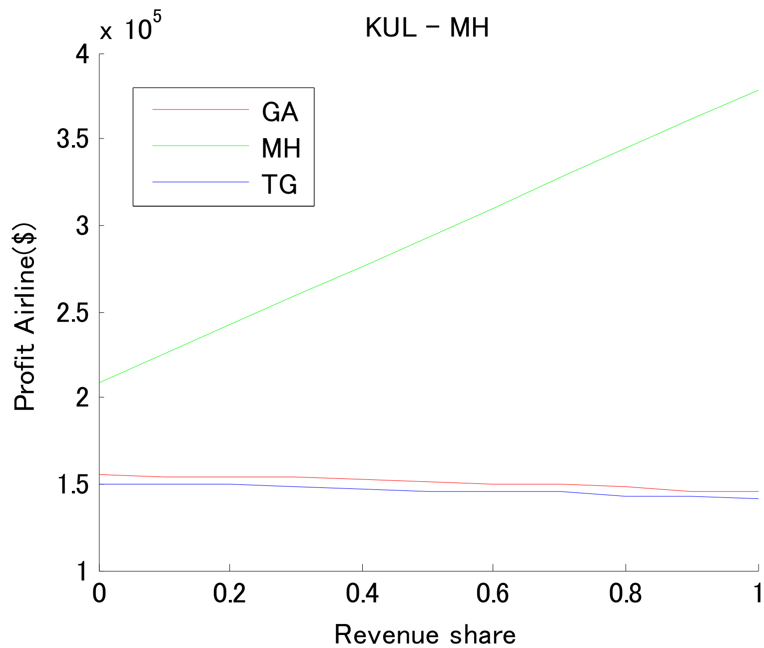


Figure 3.8 Profit of all airlines when KUL shares revenue with MH (*h* = $20)

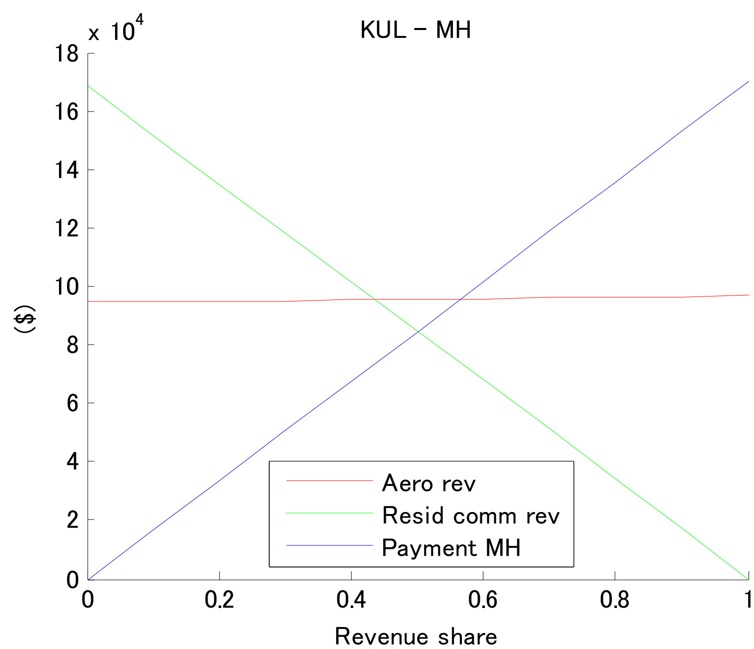


Figure 3.9 Components that comprise airport KUL profit (*h* = $20)

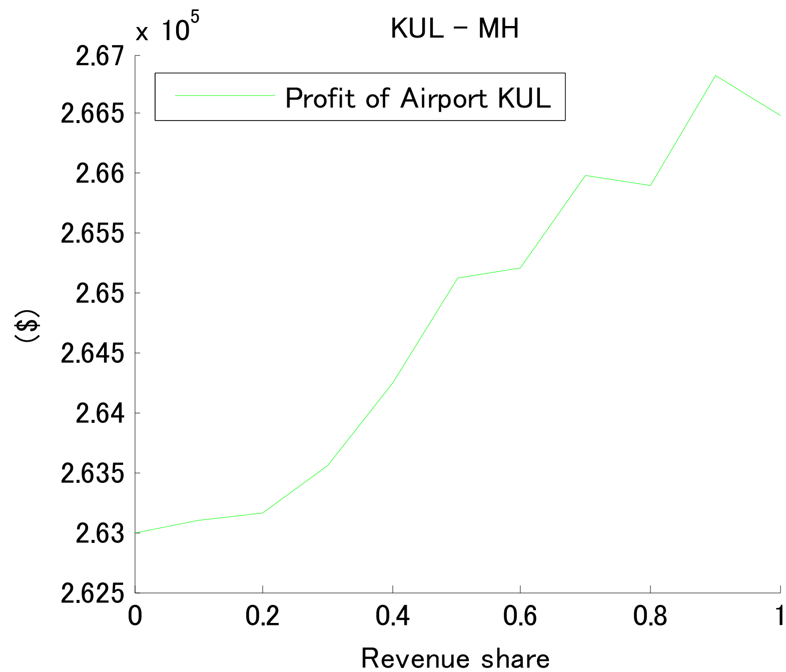


Figure 3.10 Profit of KUL with respect to revenue share *r* (*h* = \$20)

2. Revenue share allocation

Next, the result of airport's commercial revenue share allocation is examined. Each airport aims to maximize profit by determining with which airline to cooperate and by sharing a proportion of commercial revenue. An airport maximizes profit separately and sequentially.

The result of optimal revenue share allocation of the case study is provided in the Tables 3.5 and 3.6. Here, the benefit of revenue sharing derived by the airlines is examined, which is then transferred to the airport in the form of a payment (b_{in}). Since an airline is assumed to pay the maximum payment, all benefits flow to the airport; thus airline profit after revenue sharing (at t) is the same as it was before revenue sharing (at $t - 1$).

Based on the given condition, it is found that airport profit is optimal when airport cooperates with the dominant airline, namely the one that has the largest market share in that particular airport. In this case study, KUL receives the highest profit if it shares 95% of its revenue with MH, BKK shares 74% of its revenue with TG, and CGK shares 87% with GA.

However, the sequence of airports may affect the optimal revenue share. Based on our numerical result, when an airport acts as the second or third mover, its optimal revenue share becomes higher than when it acts as the first mover. Revenue sharing by the first mover increases the total number of passengers in network, which affects the revenue share of the second mover, and so on. This is in line with the result presented by Zhang et al. (2010) that airport competition results in higher degree of revenue sharing. As shown in Table 3.6, KUL, as the second mover, shares 100% of its revenue with MH (increased from 95% when it was the first mover) and BKK, as third mover, shares 85% of its revenue with TG (increased from 74% when it was the second mover). When CGK acts as the first mover, it shares 32% of its revenue with GA and 5% with TG. In summary, an airport receives its highest profit when it shares revenue with the dominant airline, although not necessarily always within an exclusive cooperation agreement. The airport may also share revenue with non-dominant airlines, most likely in smaller proportions.

All possible sequences of airports are examined and the one presented in Table 3.5 is the sequence that yields the highest social welfare. Several variations in the revenue share allocation are also examined, including when the share is divided between two or more airlines. Table 3.7 shows the variation in the commercial revenue allocation of KUL when it acts as the first mover.

In the case of network with three airlines and three airports, a unique global optimum solution is found. This global optimum solution is checked and validated with enumeration method, where a set of feasible combination of revenue share allocation solutions is checked one by one. In larger network, the revenue share allocation problem potentially has more than one global optimum solution. The analytical model of the problem can be found in Fu and Zhang (2010) and Zhang et al. (2010). Furthermore, plots of airline profit, airport profit, and social welfare, with respect to revenue share, for different initial solutions are added in Appendix B. The plots show similar trend regardless of the initial solution, such as: (1) increase in the share of commercial revenue increases airline profit before payment; (2) airport profit is optimum when airport shares revenue with the dominant airline; (3) outsider airlines are disadvantaged.

Table 3.5 Revenue share allocation (r_{in}*) KUL – BKK – CGK

Sequence	Airport (n)	r_{in}^*			$\sum_i b_{in}$ ($)	Airline Profit π ($)			Airport Profit Π ($)		
		MH	TG	GA		MH	TG	GA	KUL	BKK	CGK
$t = 0$		0	0	0	0	214,366	155,421	158,697	263,603	221,726	200,896
$t = 1$	KUL	0.95	0	0	162,513	214,366	147,476	151,341	**267,764**	222,867	201,835
$t = 2$	BKK	0	0.74	0	103,164	210,178	147,476	149,216	267,831	**224,499**	202,281
$t = 3$	CGK	0	0	0.87	125,007	209,355	143,225	149,216	267,846	224,692	**202,726**

Table 3.6 Revenue share allocation (r_{in}*) CGK – KUL – BKK

Sequence	Airport (n)	r_{in}^*			$\sum_i b_{in}$ ($)	Airline Profit π ($)			Airport Profit Π ($)		
		MH	TG	GA		MH	TG	GA	KUL	BKK	CGK
$t = 0$		0	0	0	0	214,366	155,421	158,697	263,603	221,726	200,896
$t = 1$	CGK	0	0.05	0.32	54,548	214,085	155,421	158,697	263,636	221,433	**203,322**
$t = 2$	KUL	1	0	0	169,218	214,085	145,628	149,181	**266,040**	223,035	204,306
$t = 3$	BKK	0	0.85	0	104,468	212,246	145,628	147,871	266,603	**224,461**	204,428

Table 3.7 Variation in the commercial revenue share allocation

Airport (n)	r_{in}			$\sum_i b_{in}$ ($)	Profit Airport Π_{KUL} ($)
	MH	TG	GA		
KUL (first mover)	**0.95**	**0**	**0**	**162,513**	**267,764**
	0	0.475	0.475	160,415	264,028
	0	0	0.95	158,943	262,282
	0	0.95	0	158,869	262,438
	0.7	0	0.25	154,948	258,824
	0.32	0.32	0.32	154,877	257,613
BKK (second mover)	**0**	**0.74**	**0**	**103,164**	**224,499**
	0	0	0.74	100,923	222,001
	0.37	0	0.37	99,762	220,845
	0.74	0	0	99,620	220,923
	0	0.5	0.24	97,409	218,764
	0.246	0.246	0.246	97,141	218,568
CGK (third mover)	**0**	**0**	**0.87**	**125,007**	**202,726**
	0.435	0.435	0	122,429	201,921
	0.87	0	0	122,031	201,773
	0	0	0.87	120,792	201,032
	0	0.27	0.70	120,155	200,848
	0.29	0.29	0.29	120,049	200,491

Although cooperation benefits the firms involved, it disadvantages other airlines. The results in Tables 3.5 and 3.6 suggest that non-cooperating airlines are worse-off in terms of profit (while other airports are better off, they receive additional income because of the increasing numbers of passengers in the network, triggered by revenue sharing). In the first sequence in Table 3.5, for instance, when KUL cooperates with MH, the profit of TG declines from $155,421 to $147,476, and that of GA drops from $158,697 to $151,341.

Ultimately, in the numerical result, the joint profit of each airport-airline pair is lower than at its initial level. The joint profit of MH-KUL, for example, declines from $477,969 at initial state to $477,201 at t = 3. This shows that revenue sharing competition between hub airport and dominant airline pairs, in a network where airlines serve the same ODs, may derive lower profits relative to the no-cooperation case. This situation is similar to the prisoners' dilemma. If one airport-airline pair does not cooperate in revenue sharing while another does, the former loses while the latter gains relative to the no-cooperation situation; meanwhile, when all airport-airline pairs cooperate, their joint profits fall. A similar prisoner's dilemma in vertical airport-airline cooperation was also shown in Barbot (2009) and Zhang et al. (2010). Zhang et al. (2010) considers the case of multi-airport cities/regions within which airports compete with one another, such as greater London in the UK and several metropolitan areas in the US. However, in reality no airlines serve completely similar ODs with its competitor, revenue sharing competition between hub airport and dominant airline derives higher profit relative to the no-cooperation case.

3. Social welfare

The effect of revenue sharing on social welfare is also examined. Social welfare is defined as the sum of industry profit (i.e., airline and airport profit), and consumer surplus. In commercial revenue share allocation presented in Table 3.5, social welfare increases from 4,814,709 in initial no-cooperation state into 4,869,393 at the end of sequence. The increase in social welfare is caused by the benefits received by the firms involved in cooperation and the passengers. The total number of passengers in the network increases from 10,800 to 11,017.

Relative to no-cooperation case, exclusive cooperation between an airport and its dominant airline allows the dominant airline to increase passengers at the expense of its competitors. Under that exclusive cooperation agreement, an increase in *r* potentially increases consumer surplus but reduces total industry profit in the network, as shown in the case of KUL sharing revenue only with MH, its dominant airline (Figure 3.11). Exclusive cooperation between CGK and GA also show similar pattern (Figures 3.12). Other case (BKK-TG) and Social welfare graphs are shown in Appendix.

Social welfare is then analyzed in various revenue share allocations. Table 3.8 shows industry profit, consumer surplus, social welfare when KUL shares revenue with one or more airlines (i.e., CGK and BKK do not share revenue). *Although airport prefers to cooperate with the dominant airline, such cooperation is not always optimum from social welfare point of view.* Social welfare may favor cooperation with two or more airlines rather than exclusive cooperation. For example, social welfare when KUL shares 20% revenue with GA, 30% with MH and 50% with TG is higher than when KUL shares its whole 100% revenue solely with MH.

It is difficult, however, to generalize welfare implications for all cases. Social welfare depends on cooperation parties, revenue sharing proportion, and number of airlines in the network, among others. Fu and Zhang (2010) suggest, through their analytical model, that welfare increases with a larger proportion of commercial revenue being shared in the case of homogeneous airlines services and small oligopoly. This result suggests that cooperation should be assessed case by case from social welfare aspect.

It should be pointed out that social welfare in here does not take into account consumer surplus derived from commercial activities; therefore social welfare might be underestimated. Increase in consumer surplus from commercial activities, however, can be considered linear to the increase in passenger volumes. Fu and Zhang (2010), for example, consider consumer surplus from commercial activities, as the product of total number of passengers and per passenger commercial surplus that is assumed to be positive.

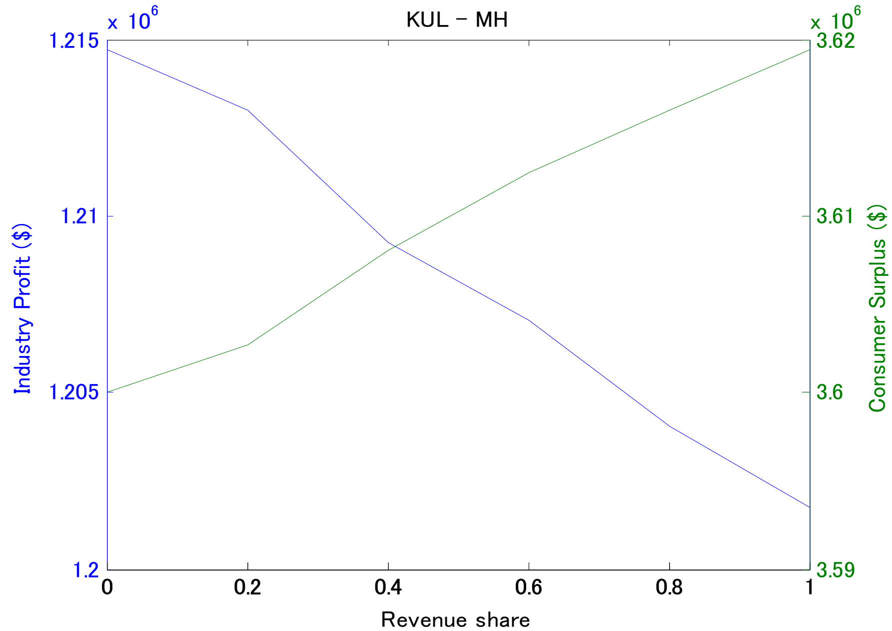


Figure 3.11 Industry profit and consumer surplus when KUL cooperates with MH

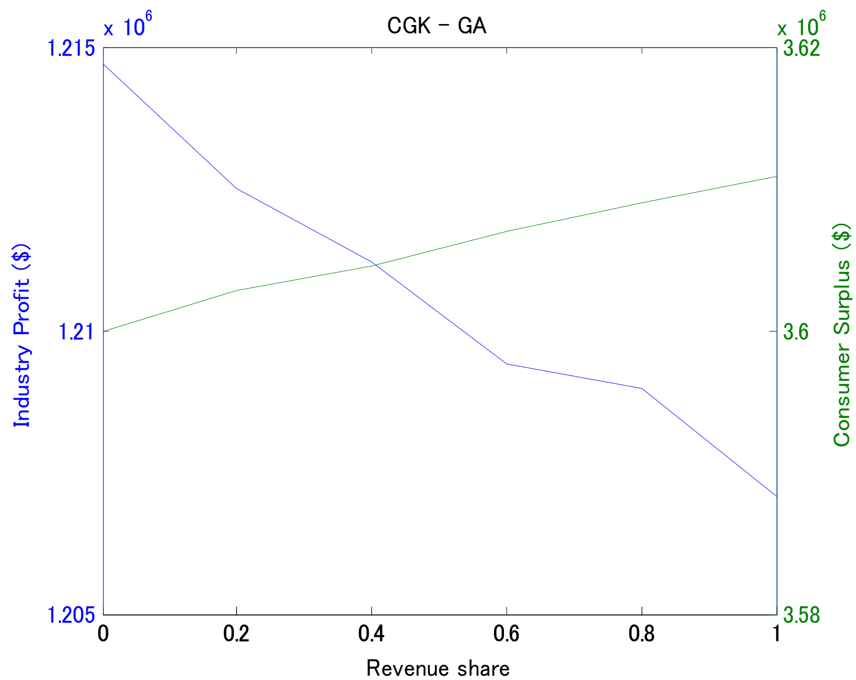


Figure 3.12 Industry profit and consumer surplus when CGK cooperates with GA

Table 3.8 Social welfare when KUL shares revenue with one or more airlines

	$r_{i\text{-KUL}}$			Industry Profit ($ 10^3)	Consumer Surplus ($ 10^3)	Social Welfare (10^3)
	GA	MH	TG			
With one airline (exclusive cooperation)	0	0	0	1,214.7	3,599.9	4,814.7
	0	0.2	0	1,212.9	3,602.7	4,815.7
	0	0.4	0	1,209.2	3,608.1	4,817.2
	0	0.6	0	1,207.0	3,612.4	4,819.5
	0	0.8	0	1,204.0	3,616.1	4,820.1
	0	1	0	1,201.7	3,619.4	**4,821.2**
With two or more airlines	0.3	0.3	0.3	1,208.5	3,612.3	4,820.8
	0.5	0	0.5	1,212.4	3,606.0	4,818.4
	0.5	0.5	0	1,206.8	3,612.0	4,818.8
	0	0.5	0.5	1,207.5	3,613.7	4,821.2
	0.5	0.3	0.2	1,208.7	3,610.5	4,819.2
	0.2	0.3	0.5	1,208.4	3,613.8	**4,822.2**

4. Case of fully-connected network

The task now is to examine the revenue share allocation in a fully-connected (i.e., liberalized) network. Consider a situation in which liberalization takes place and airlines operate with a greater degree of freedom (e.g., where direct flights can be offered from a second country to a third country). In the network illustrated in Figure 3.4, GA, MH, and TG are now assumed to offer direct flights on the BKK–KUL, CGK–BKK, and KUL–BKK routes, respectively.

In a fully-connected network, there is no connecting traffic in airports and no clear dominance by any one airline (see Table 3.9). Offering direct flights as a replacement for the previous indirect route may reduce airlines' profits: airlines that use hub-and-spoke networks have no incentive to invade each other's networks with direct flights because this approach may lower profits in the original network (see Zhang, 1996; Pels, 2008). Nonetheless, a fully-connected network benefits travelers by offering direct flights, which are more appealing; thus, it generates more passengers and raises consumer surplus.

Table 3.9 Comparison of profit and actual travel volume in hub-and-spoke (H-S) and fully-connected (F-C) networks (no cooperation)

Network	Main market share			Airline profit ($)			Actual travel volume ($\sum q_m$)	Consumer surplus
	CGK	KUL	BKK	GA	MH	TG		
H-S	45.68%	53.11%	45.88%	158,697	214,366	155,421	10,800	3,600,000
F-C	34.38%	34.88%	34.00%	134,551	127,953	139,432	11,661	3,887,000

Under a revenue sharing scheme in a fully-connected network (KUL – BKK – CGK sequence), KUL now shares 51% of its revenue with TG (b = $85,419), BKK shares 62% of revenue with GA (b = $56,100), while CGK shares 47% of its revenue with TG (b = $42,127). Revenue sharing in a fully-connected network therefore does not generate $\sum_i b_{in}$ as much as in a hub-and-spoke network (compare with $\sum_i b_{in}$ Table 3.5), there is no dominance by any one airline in each airport. The total number of passengers the network after revenue sharing increases from 11,661 to 11,728.

5. Sensitivity tests

Sensitivity tests are done in order to assess the robustness of the results to small changes in various parameters in the network model. These included changes in the value of parameters that measure potential OD demand ($q^0{}_m$), and demand sensitivity (β) as well as changes in airports capacities (y_n).

The benefit from revenue sharing is restricted by the limitations of airport capacity. For example, with KUL sharing revenue with MH and the airport's departing or landing capacity limited to 30 flights/day, additional income from revenue sharing will fall (see Table 3.10). The intuition is clear, namely without sufficient airport capacity revenue sharing is unable to fulfill its potential to generate additional income.

For a no-revenue sharing condition, an increase in potential OD demand results in more passengers, higher industry (total airline and airport) profit, and greater social welfare (see Table

3.11). Moreover, given an increase in demand sensitivity, for example, from a β of 0.003 to 0.005, fewer passengers, lower industry profit, and less social welfare can be expected.

Table 3.10 The effects of airport's capacity on the benefit of revenue sharing (KUL-MH)

Departing/landing capacity in KUL	$r_{MH - KUL}$	Flight frequency MH (one-way)		$b_{MH - KUL}$
		CGK– KUL	KUL–BKK	
y = 35	0	8	8	0
	0.2	8	8	34,588
	0.4	8	9	66,651
	0.6	8	9	99,920
	0.8	8	9	134,115
	1	8	9	169,429
y = 30	0	8	8	0
	0.2	8	8	34,588
	0.4	8	8	65,798
	0.6	8	8	98,980
	0.8	8	8	132,604
	1	8	8	158,340

Table 3.11 The effects of higher potential demand and demand sensitivity

	Number of passengers	Industry profit ($)	Social welfare
q^0 = 3000, β = 0.003	10,800	1,214,709	4,814,709
q^0 = 3200, β = 0.003	11,522	1,308,116	5,148,783
q^0 = 3000, β = 0.005	7,796	941,880	3,540,547

3.5 CONCLUSIONS AND FINDINGS

The airport and airline industries are experiencing major changes with considerable linkages emerging between the two markets as evidenced by the growing vertical cooperation between them. A commercial (i.e., non-aeronautical) revenue has a growing importance for helping an airport sustain regulated aeronautical activities; through commercial revenue sharing with airlines, it can be an essential source for profit improvement too.

This study offered an alternative model to those presented in the literature in order to investigate how commercial revenue sharing agreements influences industry profits, downstream competition, and social welfare. Methodologically, a two-stage game is developed to examine commercial revenue sharing implications on airport-airline profits, downstream competition, and social welfare. The advantages of the model are argued to be fourfold: (i) while the model is an extension of existing analytical concepts, a revenue share allocation mechanism is introduced where airports choose both particular partner airlines and the proportion of commercial revenue to share in order to maximize profits (subject to airlines' acceptance). All previous studies predetermine the cooperating parties, while in this study cooperating parties are determined by the model as an output; (ii) the model accommodates application of multiple airlines and multiple airports; (iii) the model allows analysis of revenue sharing effects in various network settings; (iv) the model can be modified to analyze other cases of cooperation, in the sense that airports transfer some benefits to airlines, such as via aeronautical charges discount.

The model, however, has limitations that can serve as future research avenues. First, the model does not cover the distribution of the total system benefit of revenue sharing to airline and airport. Second, commercial revenue per passenger (h) may be treated as endogenous instead of predetermined variable. Third, the limitation lays on the difficulty obtaining the global optimal solution in airline profit maximization. Airline profit function is not concave, thus, Nash equilibrium in airline profit maximization does not necessarily exist; and even if it does exist, it cannot be guarantee that it is unique. Furthermore, number of players (airlines and airports) in the model affects complexity in finding the solution, thus, affects computation time. Future research may focus on addressing these limitations.

The results support and supplement those put forward by previous authors. The main results are summarized as follows:

1. Commercial revenue sharing allows the airlines to exploit demand complementarities between aviation services and commercial services, which potentially leads to higher airline-airport profit.
2. Commercial revenue sharing benefits passengers as it triggers reduction of airfares in the downstream market.
3. Commercial revenue sharing favors airline dominance in airports. An airport is likely to cooperate with its dominant airline. Revenue sharing increases profit of cooperating airline; however it reduces the profit of outsider airlines.
4. Commercial revenue sharing competition between pairs of hub airport-dominant airline, in a network where airlines serve the same ODs, may derive lower profits relative to a no revenue sharing case. However, in reality no airlines serve completely similar ODs with its competitor, and in that case, revenue sharing competition between hub airport and dominant airline derives higher profit relative to no-cooperation case.
5. Commercial revenue sharing in fully-connected network does not generate payment as much as in hub-and-spoke network due to no dominance by any airline in each airport (in a fully-connected network, there is no connecting traffic in airports). Offering direct flights to substitute for the previous indirect route potentially reduces airlines' profits. Nonetheless, fully-connected network benefits travelers with the direct flights.
6. Benefit from revenue sharing is restricted by the limits of airport capacity. Without sufficient airport capacity revenue sharing could not fulfill its potential to generate additional income.

A clear finding presented herein is that an airport is likely to share revenue with the dominant airline in order to gain the optimal benefit. The numerical results also have shown that the effects of commercial revenue sharing, or other forms of airline-airport cooperation, can be two-sided. The cooperation between airport and dominant airline benefits the cooperating parties and passengers, but lower profits of the outsider airlines. The results suggest that government/regulator monitoring is possibly needed when there are practices of vertical cooperation between dominant airline and airport. Utilizing this alternative model, government or regulator may assess case per case whether revenue sharing cooperation between airlines and airports is advantageous from social welfare point of view.

Chapter 4
Air Transport Liberalization Policy in Southeast Asia

4.1 INTRODUCTION

The relationship between air transport liberalization and airline-airport cooperation was explained in Chapter two; liberalization leads to competitive market that encourages airline and airport to form cooperation. In Chapter three, through a mathematical model, it was shown that airline-airport vertical cooperation (in the form of commercial revenue sharing) may cause negative effect on airline competition. This dynamic may require government intervention in the form of competition policies.

The majority of existing literatures and researches on liberalization and airline-airport cooperation have been focusing in cases in North America and European countries as they are among the first countries that pursue and implement the ideas. However, liberalization has started to take place in developing countries, such as Southeast Asia, and therefore become an important avenue for further research.

In this chapter, the concept of air transport liberalization in Southeast Asia is explained in details. The history and agreements of the liberalization are laid out. The current liberalization status is also analyzed. Moreover, Indonesia's stance towards liberalization is highlighted. Indonesia has the region's largest economy, population, and air travel market, thus making its stance critical for the region. This chapter answered the second objective of this study: to analyze liberalization in Southeast Asia countries with respect to air transport industry. In order to achieve the objective of this chapter, a descriptive research approach is used. The author underwent a three-month internship with Economic Research Institute for ASEAN and East Asia (ERIA) to better understand the concept of regional integration in Southeast Asia. Majority of data and analysis presented in this chapter are based on various interviews conducted with the relevant sources.

4.2 ASEAN OPEN SKIES: LIBERALIZATION OF AIR TRANSPORT SERVICES IN ASEAN

The Association of Southeast Asian Nations (ASEAN) was established on August 8, 1967 by Indonesia, Malaysia, Philippines, Singapore and Thailand. Brunei later joined in 1984 followed by Vietnam (1995), Laos and Myanmar (1997) and lastly Cambodia (1999). ASEAN was formed to accelerate economic growth, social progress and cultural development in the region, and promote regional peace and stability.

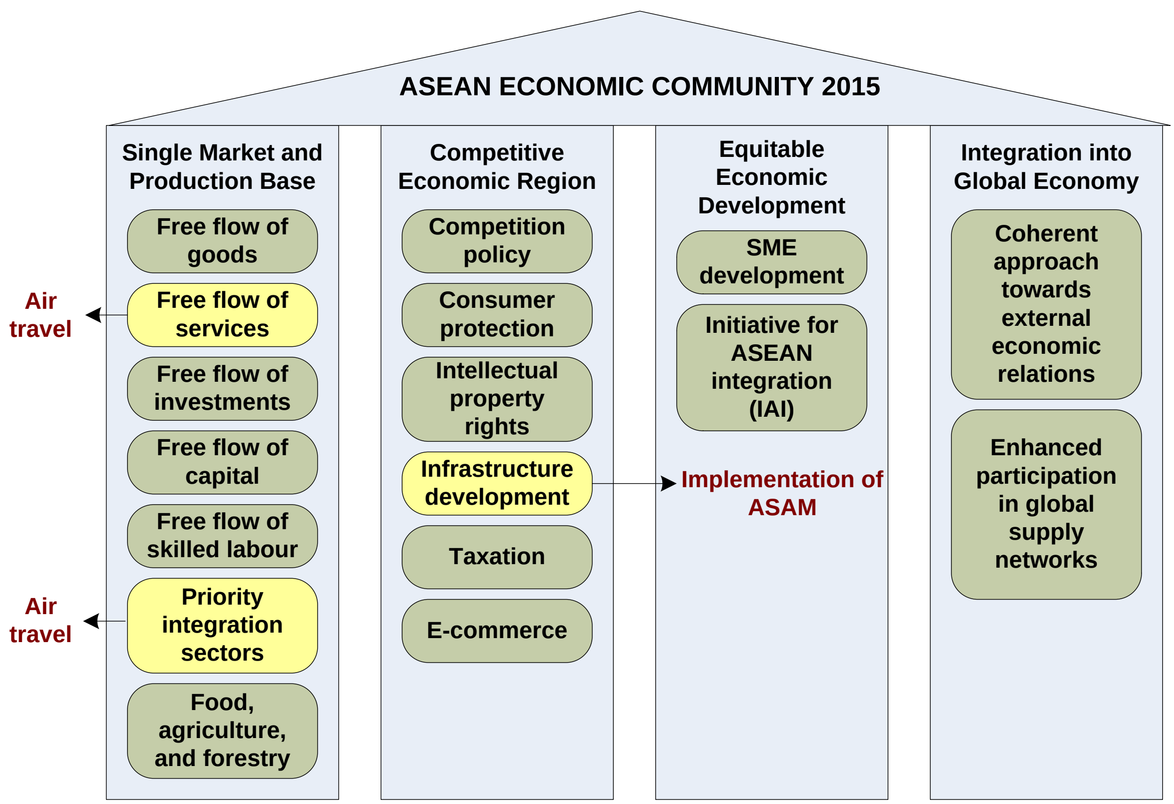
Air transport is an important sector in ASEAN as it can contribute toward economic development of its member states. The growing density of air traffic as a result of the increasing economies in the region has created motivation to pursue regional liberalization.

4.2.1 HISTORY AND AGREEMENTS

The ten member states of ASEAN have identified a 2015 deadline to establish an **ASEAN Single Aviation Market** (ASAM) for the liberalization of air transport services in the region. ASAM is commonly referred in media as **ASEAN Open Skies**. Henceforth, term ASEAN Open Skies is used.

The move toward open skies is embodied in a number of ASEAN agreements/declarations. An open skies proposal in ASEAN countries has been discussed since December 1995 during the Fifth Summit of ASEAN Leaders in Bangkok (Forsyth et al., 2006). The proposal was included as an area of the cooperation in the Plan of Action for Transport and Communications (1994-1996). Furthermore, the Successor Plan of Action in Transport (1999–2004) identified enhanced regulatory and competition policy options for the ASEAN civil aviations sector as one of its strategic thrust. The concept of liberalization of air transport services has been reaffirmed over the years at successive high-level forums, particularly at the annual ASEAN Transport Ministers' Meetings (ATMs). In November 2004, building upon earlier discussions, the 10^{th} ATM in Phnom Penh, Cambodia, adopted an Action Plan for ASEAN Air Transport Integration and Liberalization 2005–2015 (ASEAN, 2004). This Action Plan established certain strategic actions to further liberalize air services and to promote an enabling environment for a single and unified air transport market in the region. The Action Plan, together with an accompanying document known as the Roadmap for Integration of Air Travel Sector (RIATS), laid down the target date of 2015 for achieving an effective open skies regime for the region.

The discussion subsequently took place in the larger context of greater economic integration across all sectors in the region. ASEAN Open Skies is planned under broader goal of ASEAN Economic Community (AEC). The aim is to have the open skies policy in place by the time the proposed AEC takes effect in 2015. AEC consists of four pillars: (a) a single market and production base, (b) a highly competitive economic region, (c) a region of equitable economic development, and (d) a region fully integrated into the global economy (see Figure 4.1). Air travel is one of the service sectors that member states agree to liberalize, and also one of the designated 12 priority sectors for economic integration within ASEAN.



Source: adapted from ASEAN Economic Blueprint (ASEAN, 2008)

Figure 4.1 Blueprint of ASEAN Economic Community 2015

At the 13th ATM held in Singapore in November 2007, the transport ministers reaffirmed their commitment toward the implementation of open skies policy by 2015. Since then, the commitment to liberalize passenger services has been successfully incorporated into two formal legal agreements for ASEAN member states' acceptance.

These are Multilateral Agreement on Air Services (MAAS) signed in 2009 and Multilateral Agreement on the Full Liberalization of Passenger Air Services (MAFLPAS) signed in 2010. The main provisions of these agreements are: **(i)** relaxation of market access; **(ii)** relaxation of airline ownership and control; **(iii)** adoption of common policy regarding user charges, tariffs, capacity, competitive behaviors and other forms of regulation. Each of this provision is explained in details in section 4.2.2–4.2.4. Figure 4.2 summarizes all the declarations/agreements that govern the implementation of open skies policy since 1995.

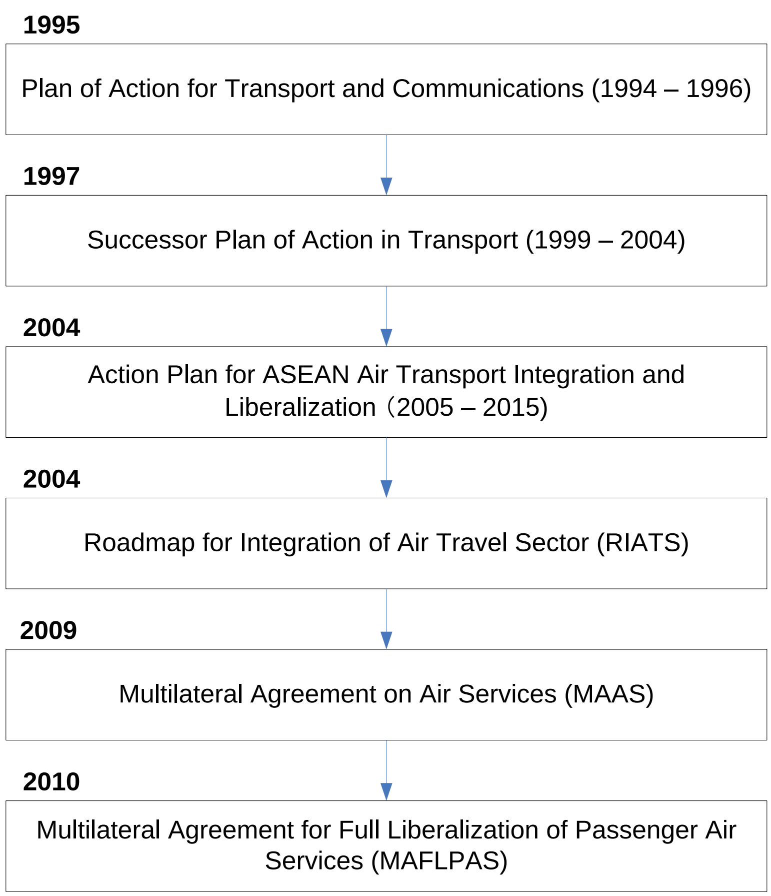


Figure 4.2 Agreements that govern the implementation of open skies policy

4.2.2 CONCEPT OF MARKET ACCESS RELAXATION

The MAAS and MAFLPAS agreements have implementing protocols that spell out the relaxation of market access in phased stages. In international aviation, market access from one country to another is negotiated by the countries in the form of freedom traffic rights (listed in Appendix A). To begin with, MAAS and MAFLPAS provide that each contracting state party will grant the designated airlines of the other contracting parties the right to fly across its territory without landing (the first freedom) and the right to make stops in its territory for non-traffic purposes (the second freedom). The implementing protocols of MAAS and MAFLPAS then proceed to lay out the following market access right as shown in Table 4.1.

The third freedom is the right for an airline to deliver passengers from the airline's home country to second country. The fourth freedom is the right for an airline to deliver passengers from second country to the airline's home country. The third and fourth freedoms are always granted together, for example an Indonesian airline can fly from Jakarta to Bangkok and vice versa. The fifth freedom is the right for an airline to take passengers from its home country, stop at the second country and continue to the third country. For example, an Indonesian airline can fly from Jakarta to Bangkok with the right to stop over in Kuala Lumpur by having a fifth freedom of traffic rights between Indonesia, Malaysia, and Thailand.

Table 4.1 Implementing protocols of MAAS and MAFLPAS agreements

	Implementing Protocols
MAAS 2009	Protocol 1. Unlimited third, fourth freedom traffic rights within the ASEAN Sub-region
	Protocol 2. Unlimited fifth freedom traffic rights within the ASEAN Sub-region
	Protocol 3. Unlimited third, fourth freedom traffic rights between the ASEAN Sub-region
	Protocol 4. Unlimited fifth freedom traffic rights between the ASEAN Sub-region
	Protocol 5. Unlimited third, fourth freedom traffic rights between ASEAN capital cities
	Protocol 6. Unlimited fifth freedom traffic rights between ASEAN capital cities
MAFLPAS 2010	Protocol 1. Unlimited third, fourth freedom traffic rights between any ASEAN cities
	Protocol 2. Unlimited fifth freedom traffic rights between any ASEAN cities

Source: MAAS and MAFLPAS Agreements

The first four implementing protocols of MAAS, Protocol 1 to 4, provide that designated airlines from each contracting party shall be allowed to operate unlimited third, fourth and fifth freedom passenger services within and between the ASEAN sub-region. To date, four sub-region agreements related to air passenger service have been formed (see Table 4.2). The sub-regions are formed based on a geographical condition, similarity of economic and aviation strength. The respective designated points in the sub-region agreements are listed in Table 4.3.

Table 4.2 Sub-regional agreements related to air passenger service

No	Agreement	Year of Conclusion	Parties
1	CLMV Multilateral Agreement on Air Services	Signed on 4 December 2003	Cambodia, Laos, Myanmar and Vietnam
2	Multilateral Agreement on the Liberalization of Passenger Air Services (MALPAS)	Signed on 27 December 2004	Brunei, Singapore and Thailand
3	Memorandum of Understanding on Expansion of Air Linkages (IMT-Growth Triangle)	Signed on 10 April 1995; amended in 1996, 2001 and on 11 August 2006	Indonesia, Malaysia and Thailand
4	Memorandum of Understanding on Expansion of Air Linkages (BIMP-East ASEAN Growth Area)	Signed on 21 February 1995; Signed new memorandum on 12 January 2007	Brunei, Indonesia, Malaysia and Philippines

Source: ASEAN Secretariat, ICAO (2009), summarized by author

As for the subsequent MAFLPAS agreement that was adopted in 2010, this was designed to supplement MAAS and to include the rest of the ASEAN cities. Hence, MAFLPAS Protocol 1 allows for unlimited third and fourth freedom operations for carriers of state parties between any cities in the region. MAFLPAS Protocol 2 provides for unlimited fifth freedom operations among cities in the region. The ratification status of each protocol in MAAS and MAFLPAS is explained in section 4.3.1.

It is important to note since all protocols only cover up to fifth freedom, open skies policy in ASEAN only accentuated on the international airports. The domestic sector is not influenced by both MAAS and MAFLPAS.

Table 4.3 Designated points in MAAS Protocols 1 to 4

Sub-region	Member States	Protocol 1: Third & fourth Freedom Within Sub-region	Protocol 2: Fifth Freedom Within Sub-region	Protocol 3: Third & fourth Freedom Between Sub-region	Protocol 4: Fifth Freedom Between Sub-region
BIMP-EAGA	Brunei	Bandar Seri Begawan	Bandar Seri Begawan	Bandar Seri Begawan	Bandar Seri Begawan
	Indonesia	Balikpapan Manado Pontianak Tarakan	Balikpapan Manado Pontianak Tarakan	Balikpapan Manado	Balikpapan Manado
	Malaysia	Kota Kinabalu Labuan Kuching Miri	Kota Kinabalu Labuan Kuching Miri	Labuan Miri	Labuan Miri
	Philippines	Davao General Santos Puerto Princesa Zamboanga	Davao General Santos Puerto Princesa Zamboanga	Davao General Santos Puerto Princesa Zamboanga	Davao Zamboanga
CLMV	Cambodia	Phnom Penh	Phnom Penh	Phnom Penh	Phnom Penh
	Laos	Vientiane Luang Prabang Pakse	Vientiane Luang Prabang Pakse	Vientiane Luang Prabang Pakse	Vientiane Luang Prabang Pakse
	Myanmar	Yangon Mandalay	Yangon Mandalay	Yangon Mandalay	Yangon Mandalay
	Vietnam	Hanoi Ho Chi Minh Da Nang Dien Bien Phu Phu Bai Cat Bi Lien Khuong	Hanoi Ho Chi Minh Da Nang Dien Bien Phu Phu Bai Cat Bi Lien Khuong	Hanoi Da Nang Dien Bien Phu Phu Bai Cat Bi Lien Khuong	Hanoi Da Nang Dien Bien Phu Phu Bai Cat Bi Lien Khuong
IMT-GT	Indonesia	Medan Padang Banda Aceh Nias	Medan Padang Banda Aceh Nias	Medan Padang	Medan Padang
	Malaysia	Penang Langkawi Alor Star Ipoh Kota Bharu	Penang Langkawi Alor Star Ipoh Kota Bharu	Alor Star Ipoh	Alor Star Ipoh
	Thailand	Hat Yai Narathiwat Pattani Trang Nakon Ski Thammarat	Hat Yai Narathiwat Pattani Trang Nakon Ski Thammarat	Hat Yai Narathiwat Pattani Trang Nakon Ski Thammarat	Hat Yai Narathiwat Pattani Trang Nakon Ski Thammarat

Source: MAAS Implementing Protocols 1 to 4

4.2.3 CONCEPT OF OWNERSHIP AND CONTROL RELAXATION

In addition to market access, open skies also requires relaxation on airline ownership and control. MAAS and MAFLPAS agreements have sought to loosen ownership and control requirements. The agreements provide that all contracting parties have the right to designate an unlimited numbers of airlines to enjoy relevant market access right, provided that the airlines fulfill the following criteria on ownership and control:

a. substantial ownership and effective control of the airlines are vested in the designating state, its nationals or both (Article 3(2)(a)(i) of MAAS); or
b. subject to the acceptance of the contracting party receiving the application of a designated airline, the airline is incorporated in and has its principal place of business in the designating state, and is (and remains) substantially owned and effectively controlled by one or more member state and/or its nationals, and the designating state has and maintains effective regulatory control (Article 3(2)(a)(ii) of MAAS); or
c. subject to the acceptance of the contracting party receiving the application of a designated airline, the airline is incorporated in and has its principal place of business in the designating state, and the designating state has and maintains effective regulatory control of that airline, provided that such arrangements will not be equivalent to allowing airline(s) or its subsidiaries access to traffic rights not otherwise available to that airline(s) (Article 3(2)(a)(iii) of MAAS).

The first alternative (a) is the traditional formulation of substantial ownership and effective control. The second alternative (b) provides for a designated airline to be incorporated in the designating state and to have its principal place of business in that state. Hence, in terms of shareholding, an airline can be owned in the majority by interests outside the designating state (but have to be owned majority by ASEAN member states), as long as the seat of incorporation and principal place of doing business remain in the designating state. Such a formulation opens the door for an airline to attract foreign capital injections from other ASEAN member states. For example, an airline from Indonesia can be owned 60% by Malaysia or any other member states.

The third alternative (c) envisages that an airline need not even have substantial ownership and effective economic control reposed within ASEAN member states, as long as it is incorporated in and has its principal place of business in the designating state. That state must also have and maintain effective regulatory control over the airline. Hence, this opens up the intriguing possibility of an airline in ASEAN being owned and economically controlled by interests from outside the region (Tan, 2013). However, this possibility comes with two major qualifications. One is the requirement that each contracting party receiving the airline's application must approve its operations. The other condition relates to the requirement that the arrangement will not be equivalent to allowing airlines or its subsidiaries access to traffic rights not otherwise available to them. This appears to reflect a concern that foreign airlines from outside the region must not be allowed to buy into an ASEAN airline and begin using it to access intra-ASEAN routes for which they have no underlying rights (Tan, 2010).

4.2.4 ADOPTION OF COMMON POLICY

Other than market access and ownership relaxation, the agreement also includes other provisions related to common policy, such as in safety and security, tariff, and competition. The agreements reaffirm the standard provisions on safety and security found in most traditional bilateral and multilateral air services agreements. Contracting parties shall recognize as valid certificates of airworthiness, certificates of competency and licenses issued or validated by the contracting party designating the airline, provided that the requirements for such certificates or licenses are at least equal to the minimum standards established pursuant to the 1944 Chicago Convention on Civil Aviation. As for aviation security, the contracting parties reaffirm their obligation to one another to protect the security of civil aviation against acts of unlawful interference. The agreements also provide for the contracting parties to act in conformity with the aviation security provisions established by ICAO and designated as annexes to the Chicago Convention.

Related to tariff, the agreements further provide in Article 7(3) of MAAS that the contracting parties agree to give particular attention to tariffs that may be objectionable because they appear "unreasonably discriminatory, unduly high or restrictive because of the abuse of a dominant position, or artificially low because of direct or indirect governmental subsidy or support or other anti-competitive practices".

On fair competition, Article 12 of MAAS provides that each contracting party agrees that each designated airline shall have a fair and equal opportunity to compete in providing international air services. Further, each contracting party agrees to take action to eliminate all forms of discrimination and/or anti-competitive practices that it deems to adversely affect the competitive position of a designated airline of any other contracting party. The agreements list practices that may be regarded as possibly anti-competitive and that may merit closer examination. These include: (a) charging fares and rates at levels which are, in the aggregate, insufficient to cover the costs of providing the air services to which they relate; (b) adding excessive capacity or frequency of air services; (c) the practices in question are sustained rather than temporary; (d) the practices in question have a serious negative economic effect on, or cause significant damage to another airline; (e) the practices in question reflect an apparent intent or have the probable effect of crippling, excluding or driving another airline from the market; (f) behavior indicating an abuse of dominant position on the route.

4.3 ASEAN OPEN SKIES: CURRENT LIBERALIZATION STATUS

This section aims to analyze the current liberalization status in ASEAN, whether it has fully complied with what stated in MAAS and MAFLPAS agreements. It is identified that liberalization is indeed occurring, albeit progressively. Member states have started to relax their control, though there are some further efforts that need to be done by member states.

4.3.1 MARKET ACCESS: RATIFICATION STATUS OF IMPLEMENTING PROTOCOLS

The critical point to be pointed out is the ratification status of ASEAN member states toward implementing protocols of MAAS and MAFLPAS. As explained before, the protocols require market access relaxation among cities in ASEAN, and these protocols must be individually accepted by member states. It is important to note that open skies in ASEAN require the ratification or acceptance of a minimum of three states before it can enter into force, and it is only among those states that have ratified or accepted it.

As of July 2013, not all 10 member states have accepted and ratified the protocols of MAAS and MAFLPAS as shown in Table 4.4 and 4.5. The parent agreement of MAAS and the implementing Protocols 1 to 4 have been ratified by all member states; however Protocols 5 and 6 have not been ratified by Indonesia and Philippines. As of MAFLPAS, only seven member states have ratified the agreement and protocols. Cambodia, Indonesia, and Laos have not ratified the parent agreement and the two implementing protocols.

Table 4.4 Ratification Status of MAAS as of July 2013

Member	MAAS	Protocol 1	Protocol 2	Protocol 3	Protocol 4	Protocol 5	Protocol 6
Brunei	✓	✓	✓	✓	✓	✓	✓
Cambodia	✓	✓	✓	✓	✓	✓	✓
Indonesia	✓	✓	✓	✓	✓	[X]	[X]
Laos	✓	✓	✓	✓	✓	✓	✓
Malaysia	✓	✓	✓	✓	✓	✓	✓
Myanmar	✓	✓	✓	✓	✓	✓	✓
Philippines	✓	✓	✓	✓	✓	[X]	[X]
Singapore	✓	✓	✓	✓	✓	✓	✓
Thailand	✓	✓	✓	✓	✓	✓	✓
Vietnam	✓	✓	✓	✓	✓	✓	✓

Source: ASEAN Secretariat (2013)

Table 4.5 Ratification Status of MAFLPAS as of July 2013

Member	MAFLPAS	Protocol 1	Protocol 2
Brunei	✓	✓	✓
Cambodia	[X]	[X]	[X]
Indonesia	[X]	[X]	[X]
Laos	[X]	[X]	[X]
Malaysia	✓	✓	✓
Myanmar	✓	✓	✓
Philippines	✓	✓	✓
Singapore	✓	✓	✓
Thailand	✓	✓	✓
Vietnam	✓	✓	✓

Source: ASEAN Secretariat (2013)

Protocols 1 to 4 in MAAS are limited in impact and relatively straightforward, thus are easily accepted by all member states. They deal with market access relaxations designed to spur growth within sub-regions straddling the boundary regions of member states (Forsyth et al., 2006). The designated points in the sub-regions covered by Protocols 1–4 in MAAS are mainly secondary and tertiary cities (see Table 4.3). In terms of air traffic volume, it is clear that Protocols 5 and 6 in MAAS have much greater significance as these cover the capital cities (i.e. Bandar Seri Begawan, Phnom Penh, Jakarta, Vientiane, Kuala Lumpur, Yangon, Manila, Singapore, Bangkok, and Hanoi).

To see the effect of the protocols, there are two cases evaluated: (a) the route liberalization in sub-region BIMP-EAGA, and (b) the route liberalization between capital cities Singapore and Kuala Lumpur. These are two extreme cases that show different liberalization effects.

a. *Route liberalization in BIMP-EAGA Sub-region* (Protocols 1 and 2)

The BIMP-EAGA sub-region cooperation initiative was formally launched in 1994 as a key strategy of participating member state to address the social and economic development of their less developed and more remote territories. The objective is to encourage increased trade, investment and tourism in the sub-region which covers the island economies of Brunei; North, Central, South and Southeast Sulawesi, Central, East, West and South Kalimantan, Maluku and Irian Jaya in Indonesia; Sabah, Sarawak and Labuan in Malaysia; and Mindanao and Palawan in the Philippines.

In 2007, the BIMP-EAGA Transport Ministers reached three transport agreements aimed at facilitating cross-border air, sea, and land connectivity, which include the landmark open skies agreement granting fifth freedom traffic rights to selected international airports in the sub-region. One of the aims is to increase tourism movement in the EAGA sub-region by 20% by 2010. However, until November 2013 there are only four direct routes between the designated points in BIMP-EAGA sub-region that are actively served by scheduled airlines (Table 4.6). MASWings suspend its twice weekly Kota Kinabalu–Balikpapan service in October 2013 (Borneo Insider, 2013).

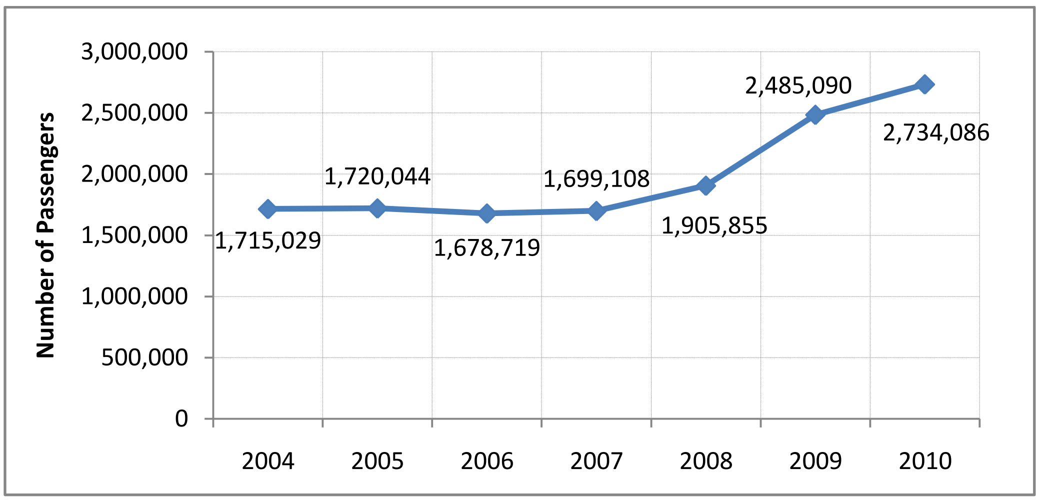
Table 4.6 Several airlines services in BIMP-EAGA

Routes served in BIMP-EAGA	Carriers	Frequency /week	Type of Aircraft
Bandar Seri Begawan – Kinabalu	Royal Brunei Airlines	13	A319/A320
Bandar Seri Begawan – Kuching	Royal Brunei Airlines	2	A319
Pontianak – Kuching	Express Air, MASWings	3 (per airline)	B737
Kota Kinabalu – Puerto Princesa	MASWings	3	ATR72

Source: Official Airline Guide (OAG) October 2013

b. *Route liberalization between Singapore–Kuala Lumpur* (Protocols 5)

The Singapore–Kuala Lumpur route had for years been restricted under 34-year-old bilateral air service agreements, and was dominated by Malaysian Airlines and Singapore Airlines as a duopoly. In February 2008, the Malaysian government finally allowed low-cost carriers AirAsia and Tiger Airways to operate on the route. The liberalization started with allowing two flights daily from each low-cost carrier, and was extended to six daily flights in September 2008. There is now unlimited capacity between Singapore and Kuala Lumpur for all airlines from the two countries. In 2013, the frequency is extended into ten daily flight for AirAsia and five daily flights for Tiger Airways. There are other low-cost carriers serving the route nowadays, namely Silk Air and Jetstar Asia. The entry of low-cost carrier into the route forced the two incumbents to lower their fares. From around $180 on average, the price went down into $30 in the third quarter of 2008 (Zhang et al., 2008). As a result there was a significant traffic growth. According to CEIC data, the airlines carried about 1.7 million passengers between the two cities in 2007 and the traffic jumped by 46.25% in 2009.



Source: CEIC Data

Figure 4.3 Air traffic Kuala Lumpur – Singapore route, 2004 – 2010

These two liberalization cases show two different effects of air service liberalization. Once regulation has been taken away, market forces take charge. The liberalization of potential high-demand route such as of Kuala Lumpur–Singapore will give apparent impacts such as increased frequency and lower price, while for low-demand route, the impacts will be smaller; it may not result in increased competition. A potentially increasing exposure to competition may explain resistance of some countries toward opening up their capital cities.

Each state's response toward market access relaxation requires elaboration. ASEAN member states have disparate levels of economic development and geography condition. They have different priority on air transport, and it is reflected in their airlines and airports competitiveness. A progressive transition to an open skies policy in ASEAN allows the smaller countries to establish the needed growth and improvement for the competition. Several key indicators for ASEAN member states are provided in Table 4.7.

Table 4.7 Selected key indicators for ASEAN member states

Member states	No. of Intl Airports	Populations 2012 (millions)	GDP 2012 (US$ billions)	Air Traffic 2011 (thousands)		Visitors Arrivals 2011 (thousands)	
				Interna-tional	Domestic	Intra-ASEAN	Extra-ASEAN
Indonesia	29	246.9	878.2	7,205	58,761	3,258	4,391
Philippines	13	96.72	250.2	12,969	36,416	332	3,586
Malaysia	11	29.24	303.5	30,462	34,239	18,885	5,829
Thailand	10	66.79	366.1	39,979	31,183	5,530	13,568
Vietnam	9	88.78	141.7	11,821	11,918	838	5,176
Laos	4	6.65	9.29	372	311	2,191	532
Cambodia	3	14.86	14.06	3,481	144	1,101	1,781
Myanmar	2	52.8	53.1	1,456	1,381	100	716
Singapore	1	5.31	274.7	46,544	n/a	5,372	7,799
Brunei	1	0.41	16.95	2,017	n/a	124	118

Source: ASEAN Statistical Year Book (2012a) and World Bank

Indonesia and Philippines are still resistant upon opening completely their capital cities (Protocols 5 and 6 of MAAS). Indonesia, particularly, see Jakarta as too big a prize to give up even if it constitutes only one point in the archipelago (Tan, 2013). Jakarta accounts for the bulk of the Indonesian economy and is the principal gateway into the country. Indonesia is currently the most resistant member state as it has not accepted most of the protocols both in MAAS and MAFLPAS. Indonesia's acceptance of the agreements is critical for the entire open skies implementation since Indonesia has the region's largest economy and population. Considering this issue, Indonesia's stance toward open skies is explained separately in Section 4.4.

Meanwhile, The Philippines decides to adopt ‘pocket open skies’ policy. It keeps restrictions on its primary airport in Manila, but offer open access to secondary airports, such as Cebu, Davao, Zamboaga and Laoag. This regulation is specified under Executive Order 29, enforced by Philippines government in March 2011. Executive Order 29 authorizes Philippine aviation panels to offer and promote “third, fourth, and fifth freedom rights to the country’s airports other than the Ninoy Aquino International Airport in Manila without restriction as to frequency, capacity and type of aircraft, and other arrangement.” This is why Philippines has ratified protocols in MAFLPAS but has not ratified Protocols 5 and 6 of MAAS.

Cambodia and Laos seem to have different reason to not ratify the protocols of MAFLPAS. They have relatively less developed aviation sectors compared to other member states. According to CEIC data in 2012, less than 2.5% of their total inbound and outbound traffic were carried by air travel services. Royal Air Cambodge was the flag carrier of Cambodia, but it ceased its operation in November 2000. Cambodia Angkor Air was established as Cambodia national airline in 2009 to replace the precursor; 49% of its shares are owned by Vietnam Airlines. The cost of operation in Lao and Cambodia are the first and second highest in ASEAN, respectively, due to import duties on fuel, high landing and parking charges (Maybank, 2013). Moreover, access and ability to funding and human resources skill are key challenges for Cambodia and Laos to expand and upgrade their aviation sector (Abidin et al., 2005).

Vietnam and Myanmar are keen to open up their markets and have ratified all agreements and protocols. This is seen a positive surprise given their restricted policy in the past. Other member states, such as Singapore, Malaysia, Brunei, and Thailand have indicated their compliance to liberalize all international airports. Singapore and Brunei in particular has pursued open skies policy since at least the 1960s (Raguraman, 1986). Both countries have no domestic market thus rely completely on international traffic. Foreign airlines are freely granted access to, from, and beyond Singapore and Brunei in exchange for reciprocal traffic rights. Singapore, Malaysia, and Thailand focuses on promoting the capital cities as an aviation hub in the region, thus favor international connection. All three main (capital) airports in the respective countries have high proportion of international traffic (see Table 4.8).

Despite resistance from some member states, ASEAN region has already seen significant traffic growth, indicated by significant increase in the flight frequencies offered by airlines. Table 4.9 shows comparison between intra-ASEAN international weekly scheduled flight frequencies in 2003 and 2011. There has been a significant increase in number of flight frequency offered by airlines in most of the routes within Southeast Asia, and the traffic growth is driven by increasing economy and booming low-cost sector (Boeing, 2013; CAPA, 2013a).

Table 4.8 Selected airports performance

Airport name	Design Capacity	Traffic 2010	% International 2010	% Domestic 2010
Kuala Lumpur (KUL)	40 million	34,087,636	**68.7%**	30.3%
Changi (SIN)	40 million	42,983,369	**100%**	0%
Suvarnabhumi (BKK)	45 million	42,496,950	**72.7%**	23.8%
Soekarno-Hatta (CGK)	38 million	44,355,998	21.9%	78.1%
Ninoy Aquino (MNL)	20 million	24,223,855	51.4%	48.6%

Source: ATRS Database (2012)

Table 4.9 Intra-ASEAN international weekly scheduled flight frequencies (2003) and 2011

O-D	Vietnam	Thailand	Laos	Cambodia	Myanmar	Malaysia	Singapore	Brunei	Philippines	Indonesia
Vietnam		(75) 75	(8) 52	(62) 182	(0) 8	(18) 76	(30) 102	(0) 3	(3) 14	(0) 11
Thailand	(69) 84		(32) 51	(91) 91	(31) 49	(66) 183	(177) 226	(5) 7	(36) 42	(14) 336
Laos	(13) 39	(27) 51		(11) 22	(0) 0	(0) 3	(0) 0	(0) 0	(0) 0	(0) 0
Cambodia	(57) 103	(91) 91	(11) 30		(0) 1	(10) 33	(15) 37	(0) 0	(0) 0	(0) 1
Myanmar	(0) 3	(34) 49	(0) 0	(0) 1		(4) 19	(12) 37	(0) 0	(0) 0	(0) 0
Malaysia	(20) 76	(78) 163	(0) 3	(14) 33	(4) 19		(236) 396	(21) 37	(22) 27	(144) 519
Singapore	(31) 102	(185) 166	(0) 0	(15) 37	(12) 35	(243) 418		(18) 21	(19) 151	(260) 574
Brunei	(0) 3	(6) 7	(0) 0	(0) 0	(0) 0	(20) 39	(22) 35		(5) 10	(14) 21
Philippines	(3) 14	(41) 42	(0) 0	(0) 0	(0) 0	(24) 27	(43) 151	(0) 10		(5) 16
Indonesia	(0) 11	(14) 336	(0) 0	(0) 0	(0) 0	(150) 410	(262) 590	(10) 10	(0) 16	

Source: Leinbach (2004) and Official Airline Guide collected by author

4.3.2 OWNERSHIP AND EFFECTIVE CONTROL: CURRENT STATUS

As explained before, open skies policy that is embedded in MAAS and MAFLPAS agreements allow principal place of business concept for the designated airline. However, just like market access, airline ownership and control in ASEAN member states remain highly restricted. In most of air service agreements between individual ASEAN states, it is a common condition that airlines designated by the respective governments to enjoy relevant third, fourth and fifth freedom market access rights must be must be substantially owned and effectively controlled by the designating state and its nationals. This means that foreign interests' stakes in a local airline cannot exceed 49% shareholding. In some states such as Vietnam and Philippines, the foreign ownership restriction is even stricter. In Vietnam, foreign ownership is limited to 30% for single investor and 49% in total (InterVISTAS, 2009a). In Philippines, no foreign interest can own more than 40% of shareholding (see Table 4.10). Singapore is the most liberal in the region as it does not limit foreign ownership in airlines. However, the flag airline of Singapore, Singapore Airlines, maintains a corporate policy to restrict foreign ownership less than 50% (InterVISTAS, 2009b).

Table 4.10 Foreign ownership and tariff regulation in ASEAN member states (2013)

Member States	Domestic tariff regulated	International tariff regulated	Foreign equity participation in commercial airline
Brunei	-	No	Puts limitation, but no numerical limited is stated
Cambodia	Yes	Yes	Puts limitation, but no numerical limited is stated
Singapore	-	No	No limitation on equity participation
Indonesia	Yes	No	Maximum permitted foreign equity is 49%
Malaysia	No	No	Maximum permitted foreign equity is 49%
Myanmar	No	No	Puts limitation, but no numerical limited is stated
Vietnam	Yes	No	Maximum permitted is 30% (single foreign investor) and 49% (total foreign equity)
Philippines	Yes	Yes	Maximum permitted foreign equity is 40%
Lao PDR	Yes	No	Puts limitation, but no numerical limited is stated
Thailand	Yes	Yes	Maximum permitted foreign equity is 49%

Source: Member states' aviation policies and investment regulations

Given the ownership and control restrictions, airline companies could extend their networks and enter new regional market only through joint-venture or subsidiary arrangements. This is what has been applied by AirAsia, a Malaysian low-cost carrier, since 2004. AirAsia establishes local subsidiaries in Thailand, Indonesia and Philippines, so that it can operate and set base in each respective country. Each subsidiary is therefore majority-owned and effectively control by local interest.

This method of expansion, called “branchizing” (Poon and Waring, 2010), is an effective method that industry players use to get around substantial ownership regulation. AirAsia Malaysia cannot serve direct Jakarta and Singapore route, but AirAsia Indonesia (owned majority by Indonesia counterpart and only minority by AirAsia Malaysia) can serve Jakarta and Singapore route, exercising simple third and fourth freedom belonging to Indonesia.

AirAsia have set up subsidiaries in Thailand (Thai AirAsia), Indonesia (Indonesia AirAsia), and Philippines. The partnership in Philippines is a unique case as it involves formation of new subsidiary (AirAsia Philippines) and takeover of an existing domestic airline and (AirAsia Zest). Lion Air, an Indonesian low-cost carrier, also establishes new airline in Malaysia (Malindo Air) and in Thailand (Thai Lion Air). Utilizing this method, Lion and AirAsia have successfully become the two biggest LCCs in Southeast Asia in term of capacity. Lion Air group and AirAsia group holds 37% and 32% capacity share in Southeast Asia, respectively (CAPA, 2013a).

There are other low-cost carriers that use similar method. Jetstar Airways, an Australian low-cost carrier, establish local airlines in Singapore (Jetstar Asia) and in Vietnam (Jetstar Pacific). Tigerair, a Singapore low-cost carrier, establish subsidiaries in Indonesia (Tigerair Mandala) and in Philippines (Tigerair Philippines). This method allows airlines to grow, expand network to other states under the ownership regulation, and thus increase traffic. However, this situation certainly does not yet comply with principal place of business alternatives suggested by MAAS and MAFLPAS agreements. Table 4.11 lists all cross-country joint-venture airlines in Southeast Asia along with their shareholders as of December 2013 and their hub locations.

Table 4.11 Joint-venture airlines in Southeast Asia

Joint venture airlines	Foreign partner	Local partner	Hub Airport, City
Thai AirAsia	AirAsia Group (45%)	Asia Aviation (55%)	Don Mueang, Bangkok
Indonesia AirAsia	AirAsia Group (49%)	Fersindo Nusaperkasa (51%)	Soekarno Hatta, Jakarta
Philippines AirAsia	AirAsia Group (40%)	Antonio Cojuangco, Michael Romero, Marianne Hontiveros (60%)	Clark, Angeles
AirAsia Zest	AirAsia Philippines (49%)	AMY Holdings (51%)	Ninoy Aquino, Manila
Tigerair Mandala	Tiger Airways Group (33%)	Saratoga Investama (51%)	Soekarno Hatta, Jakarta
Tigerair Philippines	Tiger Airways Group (40%)	SEAir (60%)	Ninoy Aquino, Manila (domestic) and Clark, Angeles (international)
Jetstar Asia	Qantas Group (49%)	Westbrook Investment (51%)	Changi, Singapore
Jetstar Pacific	Qantas Group (30%)	Vietnam Airlines (70%)	Tan Son Nhat, Ho Chi Minh
Malindo Air	Lion Air Group (49%)	National Aerospace and Defense Industries (51%)	Kuala Lumpur International, Kuala Lumpur
Thai Lion Air	Lion Air Group (49%)	Thai domestic entity (51%)	Don Mueang, Bangkok

Source: airlines' websites and annual reports

4.3.3 LIMITATIONS OF ASEAN OPEN SKIES POLICY: IN CONCEPT AND PRACTICE

Based on the aforementioned assessment, the current situation of liberalization in ASEAN is still somewhere in between traditional regulated bilateral approach and open skies. Third, fourth and fifth freedom of traffic rights with increasing capacity and multiple airlines are enforced, albeit limited to certain cities. Substantial ownership and control regulation is still embedded in the each designated state (see Table 4.12). Most of the member states have ratified the agreement, albeit a few countries are holding back on some of the protocols. The ratifications of all member states are important for open skies to be beneficial substantially in the region; fully unlimited third, fourth, and fifth freedom of rights in the region can be effective only if all member states ratified and accepted the agreements.

Table 4.12 Comparison of traditional bilateral, open skies, current liberalization in ASEAN

	Traditional bilateral approach	ASEAN open skies policy	Current liberalization stage
Market access	Limited third, fourth, and fifth freedoms	Unlimited third, fourth, and fifth freedoms	Unlimited third, fourth, and fifth freedom with predetermined access point
Designation	Single or double or multiple (predetermined)	Multiple designations	Multiple designations
Ownership and effective control of airline	Substantial ownership and effective control in the designated state	Principal place of business in the designated state[a]	Substantial ownership and effective control in the designated state
Capacity	Determined frequency and aircraft type (quota)	Unrestricted, subject to approval	Increases, subject to approval
Fares	Both government approval (double approval)	Tariffs charged by airlines need not be filed or approved by either contracting party[b]	Single disapproval in general

Source: author

[a] Subject to acceptance of the contracting party receiving the application of a designated airline
[b] In the event the national law of a Contracting Party requires prior approval of a tariff, the tariff application shall be dealt with accordingly.

Furthermore, it is necessary to note that current open skies policy embedded in MAAS and MAFLPAS is less ‘open’ than liberalization practices in other region, e.g. EU Common Aviation Area (commonly referred as EU Open Skies). Unlike in EU, open skies policy in ASEAN does not enforce seventh freedom and cabotage right (eighth and ninth freedoms). It also still puts limitation on foreign ownership among the member states. There is also the absence of a unified single regulator and each country retains full regulatory control (see Table 4.13).

Third, fourth, and fifth freedom of flight will enable airlines to access more cities within the ASEAN region, and also the right to fly beyond the first destination onwards to the second destination in the region – provided that the routes are international routes. Since the seventh, eighth and ninth freedom rights are absent from the ASEAN multilateral agreements, domestic markets are still very much insulated from liberalization. The term ‘open’ is therefore a relative statement in ASEAN. The skies are more open than previously but it is only accentuated on the international airports. This whole review thus highlights that air transport liberalization in ASEAN is limited both in concept (agreement) and in practice (implementation).

Table 4.13 Comparison between EU Open Skies and ASEAN Open Skies

	European Union (1997)	**ASEAN (2015)**
Freedoms of flight	1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th	1st, 2nd, 3rd, 4th, 5th
Foreign ownership limits	None for EU members	Up to 49% for ASEAN members
Limits on price and capacity	None	None
Single regulator for aviation industry	Yes	No. Each country enforces its own laws and regulations
Movements in labor	Free flow of labor	Free flow for skilled labor only

Source: EU Common Aviation agreements, ASEAN agreements

4.4 AVIATION POLICY IN INDONESIA AND ITS RELATION TO ASEAN OPEN SKIES

Indonesia has the largest population and area within ASEAN region. Indonesia's population of 246.9 million represents 40% of the total population and its land area of 1.86 million square kilometer represents 42% of total land area in the region. The position is that, Indonesia as a big archipelago has potentially many points to offer international aviation, whereas the other member states (particularly Singapore) have all of one point to offer. This circumstance is perceived as systemic imbalance for exchanging traffic rights, thus lead to an issue—often raised by Indonesian government and industry stakeholders—whether benefits of air transport liberalization will accrue equally among member states.

With this context in mind, this section seeks to clarify the development of Indonesia's aviation policy and industry. Little attention has been given to the reform in Indonesia's air transport policy and industry. Indonesia's stance toward ASEAN open skies is then highlighted, to clarify whether Indonesia is committed and ready to implement open skies policy in ASEAN. As the largest state in ASEAN in terms of population and air travel market, Indonesia's participation will very much affect the effectiveness of the proposed air transport liberalization.

4.4.1 AIR TRANSPORT REGULATORY IN INDONESIA

Aviation law in Indonesia is first enacted in 1958 and it has been amended twice in 1992 and 2009. The latest is Law No. 1/2009 on Aviation in which specifies broad regulations on airports and airlines, including regulation on scheduled and non-scheduled air passenger service. This law is supplemented by other decrees, e.g., government and minister decrees, which support the regulation in more specific details, for example on airline maintenance and tariff issues.

Deregulation of Indonesia domestic market is started in 1999 through the enforcement of Law No. 5/1999 that restricts any monopoly practices including in air transport sector. Prior to deregulation, domestic and international flights were served dominantly by Garuda Indonesia and Merpati Airlines, both are state-owned airlines. Deregulation brought significant changes to the domestic aviation landscape, especially after the advent of Minister Decree No. 11/2001 that allowed scheduled airline to obtain license by only operating two aircrafts. The number of scheduled airline companies increased from 7 in 1999 into 27 in 2004, according to data from Ministry of Transportation. Until now domestic market can be served only by local airlines where foreign ownership is limited to non-dominant 49% share. Domestic airline tariff also remains regulated where government enforces ceiling prices for all domestic routes.

As in many countries in Asia and elsewhere, aviation industry in Indonesia remains moderately liberalized. Market access is given mostly through bilateral agreements with selected trading partners. With regards to open skies, government is cautious in relaxing market access rights. Government opts for a gradual liberalization rather than a rapid approach as emphasized in Article 90 of Law No 1/2009, "market liberalization towards the unrestricted air space (open skies) to and from Indonesia for foreign airlines shall be implemented gradually by bilateral and multilateral agreement."

As of February 2013, Indonesia has air service agreements with approximately 65 countries. Horizontal agreement between Indonesia and European Union (EU) is signed in 2011 (European Commission, 2011). A horizontal agreement is an international agreement negotiated by the Commission on behalf of all EU Member States with a third country. EU–Indonesia horizontal agreement places several provisions in air service between EU member states and Indonesia; it removes nationality restrictions and allows any EU carriers to operate flights between Indonesia and EU member states. The agreement, however only applies to EU member states where a bilateral agreement with Indonesia already exists. This is in line with Article 87 of Law No 1/2009 stating that “in the case of plurilateral agreements on air transport with an organization/a community of foreign countries, the implementation of the agreement is conducted based on bilateral agreements with each country member.”

Indonesia also conducts open skies agreement with the United States (US). The agreement is signed in 2004 and it removes restrictions on fare, capacity, frequency, type of aircraft, and number of designated airlines. It allows any US airline to conduct passenger service from points in the US and intermediate points to any points in Indonesia (fifth freedom) and also allows cargo service between Indonesia and any points in the world (seventh freedom). Garuda Indonesia is currently the only Indonesian carrier serving EU-Indonesia and US-Indonesia routes, and mostly through code sharing with other foreign airlines.

On December 2012, government announces a roadmap of international relation on air services through Decision of the Director General No. 480/2012 as a response towards increasing number of market access requests from other countries. With regards to any bilateral and multilateral agreements, the decree allows market access traffic right for foreign airlines only up to fifth freedom, thus continues to resist domestic cabotage operation. The decree allows agreements entailing double disapproval tariff and multi designated airlines.

The regulations for aviation sector are administered by the Directorate General of Civil Aviation (DGCA), an agency under Ministry of Transportation. DGCA also holds the role to manage most of airports in the country through its technical operation units. There are 233 public airports in Indonesia. Twenty-six public airports are managed by two separate state-owned companies, Angkasa Pura I and Angkasa Pura II, while the other airports are managed by DGCA. Within this context, DGCA currently performs two roles, as regulator and airport operator.

DGCA, together with Angkasa Pura I and Angkasa Pura II, were also responsible for providing air navigation service in every airport that they manage. The authority was taken over in January 2013 by Indonesia Air Navigation Service Provider (PPNPI), a newly-established non-profit state-owned company. PPNPI performs as a single air traffic manager in the country.

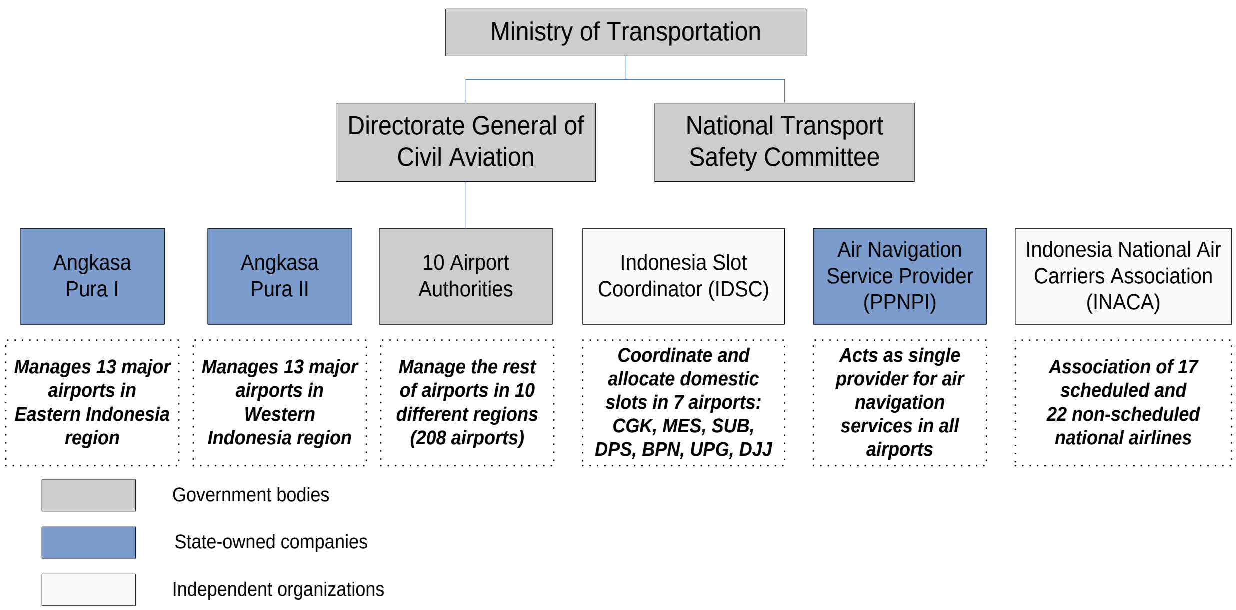
Table 4.14 Slot coordinators in ASEAN member states

Member states	Airport slot coordinator	Status of slot coordinator
Singapore	Changi Airport Slot Coordinator	Independent organization under air transport regulator
Malaysia	Airport Coordination Malaysia	
Thailand	Slot Coordination Committee Thailand	
Vietnam	Civil Aviation Administration of Vietnam	Air transport regulator
Cambodia	State Secretariat of Civil Aviation	
Indonesia	Indonesia Slot Coordinator (domestic), Garuda Indonesia (international)	Independent organization and flag airlines
Philippines	Philippine Airlines	Flag airlines

Source: Ministry of Transportation of each member state

Indonesia's flag airline, Garuda Indonesia, holds the authority to coordinate and allocate international flight slots in airport, and this is a general mechanism in Asia Pacific in the early development of air transport sector (Hooper, 2002). Slot coordinating authorities in many countries are nowadays held by independent bodies or by the air transport regulator. Indonesia and Philippines are two of ASEAN member states that assign the slot coordination authority to flag airline (see Table 4.14). Due to increasing traffic in major airports, Indonesia Slot Coordinator (IDSC) is finally established in 2011, specified under Directorate General Regulation No. 569/2011, as a separate agency to coordinate domestic flights slots. There are seven airports that are coordinated by IDSC: airports in Jakarta, Surabaya, Denpasar, Medan, Makassar, Balikpapan and Jayapura. Despite IDSC status as a separate agency, it is still headed by Garuda Indonesia's officer.

Figure 4.4 shows the overview of air transport bodies in Indonesia. The roles of government are very significant in air transport sector. Most of the tasks are done by government agencies or government-owned companies.



Source: author according to information collected from the Ministry of Transportation

Figure 4.4 Air transport bodies in Indonesia

4.4.2 AIRPORT AND AIRLINE INDUSTRY IN INDONESIA

1. Airport Industry

All public airports in Indonesia are owned and managed by the government through state-owned companies (Angkasa Pura I and Angkasa Pura II) and airport authorities of DGCA. The state-owned companies and the airport authorities are responsible in managing aeronautical non-traffic and commercial services in airports. Angkasa Pura I manages 13 major airports in Eastern region, while Angkasa Pura II manages 13 major airports in Western region, including capital city airport's Soekarno-Hatta.

Minister Decree No. 11/2001 contains regulations related to airport operation. The decree entails airports to be categorized into two types: hub and spoke airports. Hub airports are categorized into three: primary, secondary, and tertiary hubs. Currently there are 68 hubs out of 233 public airports and among them there are 8 primary, 19 secondary and 41 tertiary hubs. Primary hubs are those that handle more than 5 million passengers per year. Majority of the spoke airports require financial support and subsidies from government. It is reviewed that there are over 90 spoke airports with annual air passenger traffic below 500,000 in Indonesia. Many of these airports are losing money and hence require financial support (Carnis and Yuliawati, 2013).

Table 4.15 Comparison of capacity, traffic, and planned expansion in selected airports in Indonesia

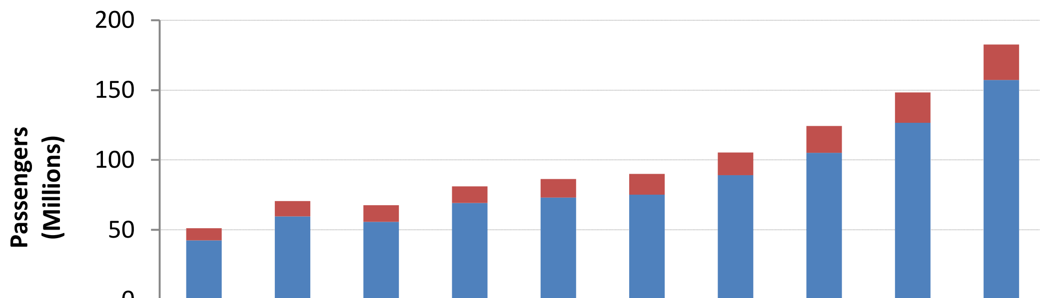
(in Million Passengers)	Jakarta	Surabaya	Denpasar	Makassar	Medan	Balikpapan	Yogyakarta
Traffic in 2012	**52.5**	**13.8**	**12.8**	**7.5**	**7.2**	**5.6**	**4.3**
Capacity	**22**	**7.4**	**9.4**	**7.3**	**1**	**1.4**	**1**
Planned Expansion	62	12	25	-	9	11	-

Source: Angkasa Pura I, Angkasa Pura II (retrieved from interview)

Sixteen of Indonesia's 26 largest airports are currently operating above design capacity, according to data from Angkasa Pura I and Angkasa Pura II. Jakarta is the most congested, with existing terminals operating well above capacity and the airport's two runways fully utilized during peak hours. The airport serves more than 50 million passengers in 2012, more than twice its design capacity. A major upgrade project for Soekarno-Hatta Airport finally commenced in 2013 and will increase airport's capacity to 62 million passengers. However, by the time the project is completed (expected to be 2015) the airport will likely again be operating above capacity. Several other major airport expansions are undergoing (see Table 4.15). Expansion in Surabaya airport is expected to be finished in 2013, although it will still be behind the growth curve as the expansion will only increase the capacity to 12 million passengers, a figure it has already surpassed. New airport is built in Medan (Kuala Namu Airport) with capacity of 9 million passengers to replace the old Polonia Airport. Airport expansions in Denpasar and Balikpapan are also expected to finish in 2013.

2. Airline Industry

From airline industry point of view, there has been a substantial growth. Indonesia's economy has experienced a significant growth in the past years, contributing to soaring demand of air travel. In 2012, there were 157 million domestic passengers and 25 million international passengers (see Figure 4.5) where 48% of them travelling to ASEAN states. The total traffic increased by 23% from 2011 and the growth is projected to continue.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
International	8.69	10.95	11.86	11.70	13.37	14.74	16.31	19.24	21.74	25.32
Domestic	42.53	59.75	55.79	69.36	73.10	75.27	89.07	105.07	126.53	157.21

Source: Angkasa Pura I, Angkasa Pura II, Ministry of Transportation (retrieved from interview)

Figure 4.5 Domestic and international air traffic in Indonesia (2003–2012)

After the advent of Minister Decree No. 11/2001 that allows airline to obtain license only by operating two aircrafts, the number of airline companies increased rapidly and creating safety concern. After series of accidents, all Indonesian airlines were banned by the EU in 2007. Under current law on aviation, airlines seeking a license must own at least five aircrafts. As of February 2013, there are eight major scheduled airlines operating in Indonesia and among them, Garuda Indonesia, Tiger Mandala, Batavia, Indonesia AirAsia, are no longer banned from entering EU.

Airline groups in Indonesia own several brand identities where the main company offers different service from the subsidiary (see Figure 4.6). This strategy aims to accommodate ranges of customers, from low-end to high-end customers. Indonesia is possibly unique as it is the only country with law that requires airline companies to identify their services into three categories: no-frill, medium, or full service. For each category, different ceiling prices are imposed for domestic flights, stipulated under Minister Decree No.26/2010, which are 100%, 90% and 85% of stated ceiling prices, respectively for full-service, medium and no-frill airlines.

Five largest airlines (i.e., Lion, Garuda, Indonesia AirAsia, Sriwijaya, and Batavia) account for more than 90% of the domestic and international routes in 2012 (see Table 4.16). Batavia stops operation since 30 January 2013 due to bankruptcy (Osman, 2013).

Source: adapted from Center of Asia Pacific Aviation (2013)

Figure 4.6 Market positioning of major scheduled airlines in Indonesia

Private-owned Lion Group is the domestic market leader and captured around 41% of the domestic market share in 2012, including 3% share by its regional subsidiary Wings Air. Flag carrier and publicly traded airline group Garuda is committed to closing the gap with Lion by focusing on rapid domestic growth at both ends of the market. Garuda Indonesia positions as the leader at the full-service end of the market targeting for premium passengers, while its subsidiary Citilink focuses at low-cost end competing with Lion on domestic trunk routes. Meanwhile, Indonesia AirAsia is the international market leader and capture around 40% of the market share.

Wide archipelagic area of Indonesia requires airlines to have multiple hubs. Other than Jakarta, some airlines set up hub in Surabaya, Denpasar, or Makassar. Consolidation in Indonesia is likely in the next years given there are now eight major airlines competing on trunk routes. Considering the character of airline industry with relatively low operating margin, airlines may find it difficult to recover their full cost in such competitive markets, even in a market with 231 million populations. The smaller domestic carriers, or those in the middle of market between the low-cost and full-service business models, are the most vulnerable, as the case of Batavia.

Table 4.16 Market share of major scheduled airlines in Indonesia

Major Scheduled Airlines	Market share (domestic) 2012	Market share (international) 2012	First Hub	Second Hub	Ownership/Status
Garuda Indonesia	**22.82%**	**37.03%**	Jakarta	Denpasar	State-listed (Government 69.14%, Listed 27.98%)
Lion Air	**41.59%**	10.80%	Jakarta	Surabaya	Private-owned
Indonesia AirAsia	2.20%	**40.58%**	Jakarta	Denpasar	Private-owned (AirAsia Berhad 49%)
Sriwijaya Air	12.20%	2.25%	Jakarta	Surabaya	Private-owned
Batavia Air*	10.25%	3.59%	Jakarta	Surabaya	Private-owned
Merpati Nusantara	2.64%	1.10%	Makassar	Surabaya	State-owned (Government 95.79%, Garuda 4.21%)
Wings Air	3.37%	1.43%	Makassar	Surabaya	Subsidiary of Lion
Citilink	2.12%	0%	Surabaya	Jakarta	Subsidiary of Garuda
Tiger Mandala	1.81%	3.22%	Jakarta	Medan	Private-owned (Tiger 33%)

Note: Batavia Air filed bankruptcy in January 2013

Source: Indonesia National Air Carriers Association (retrieved from interview)

4.4.3 INDONESIA'S STANCE TOWARDS OPEN SKIES

As pointed out in the previous section, Indonesia is the most resistant member states regarding the implementation of open skies policy in ASEAN. Indonesia has not ratified Protocols 5 and 6 of MAAS as well as Protocols 1 and 2 of MAFLPAS. That means Indonesia has only ratified third, fourth, fifth freedom of flights for secondary cities mentioned in the sub-region agreement IMT-GT and BIMP-EAGA, but hold back in implementing freedom of flights in the other cities including the capital city.

Through Decision of Directorate General No. 480/2012, Indonesian government set a specific target for ratification of both multilateral agreements. This target is different from the target specified by ASEAN (see Table 4.17). In 2013, Indonesia plans to ratify Protocols 1 and 2 of MAFLPAS only to several designated points (i.e., Jakarta, Surabaya, Medan, Makassar, and Denpasar). In 2014, Indonesia plans to ratify Protocols 5 and 6 of MAAS, and not until 2015 that Indonesia will include all international points in the ratification of both protocols in MAFLPAS.

Table 4.17 ASEAN multilateral agreements on air passenger services

Agreements	Implementing Protocols	ASEAN target	Indonesia target
MAAS (2009)	Protocol 1. Unlimited third and fourth freedom traffic rights within the ASEAN Sub-region	December 2008	2011-2012
	Protocol 2. Unlimited fifth freedom traffic rights within the ASEAN Sub-region	December 2008	2011-2012
	Protocol 3. Unlimited third and fourth freedom traffic rights between the ASEAN Sub-region	December 2008	2011-2012
	Protocol 4. Unlimited fifth freedom traffic rights between the ASEAN Sub-region	December 2008	2011-2012
	Protocol 5. Unlimited third and fourth freedom traffic rights between ASEAN capital cities	December 2008	2014
	Protocol 6. Unlimited fifth freedom traffic rights between ASEAN capital cities	December 2010	2014
MAFLPAS (2010)	Protocol 1. Unlimited third and fourth freedom traffic rights between any ASEAN cities	June 2010	2013[a], 2015[b]
	Protocol 2. Unlimited fifth freedom traffic rights between any ASEAN cities	June 2013	2013[a], 2015[b]

Note: (a) Unlimited third, fourth, and fifth freedom for any ASEAN airlines to/from designated points in Indonesia (Jakarta, Medan, Surabaya, Makassar and Denpasar); (b) Unlimited third, fourth, and fifth freedom for any ASEAN airlines to/from all points in Indonesia

Source: ASEAN Secretariat, Decision of Director General No. 480/2012, INACA

Further, the government also set five strategies to address ASEAN Single Aviation Market 2015 (under Decision of Directorate General No. 480/2012), namely: (i) withholding cabotage rights; (ii) ratification of the multilateral agreements is done gradually; (iii) ratification of multilateral agreements is based on national law and principle of fairness and reciprocity; (iv) plurilateral agreement between Indonesia and community of certain countries is done based on what stated in that agreement; (v) market access rights for points in sub-regional agreements IMT-GT and BIMP-EAGA can be granted in a more liberal manner in order to enhance the growth in the sub-region.

Indonesia therefore opts to implement liberalization gradually on progressive basis – most likely to give time for the airline industry to adjust. This is evident from previous regulation on market access that is imposed by the government. In March 2005, for instance, government imposed ban on new low-cost carriers' operations to four major cities: Jakarta, Surabaya, Denpasar, and Medan. Then later in early 2009, Indonesia relaxed the ban on the Singapore low-cost, Tigerair, with the condition that Tiger revamps its services to Indonesia to offer more premium airline services (Liaw, 2009). In January 2013, Indonesian and Singaporean government finally agree to allow airlines from both countries to fly more often between Changi Airport and several Indonesia cities, including Jakarta, Surabaya and Medan. Garuda Indonesia and Lion Air also have been given permission to carry out flights from Singapore to other parts of Asia (Kaur, 2013).

The opposing parties come from Indonesian carriers (IndII, 2012; Tan, 2013). Through Indonesian National Air Carrier Association (INACA), Indonesian carriers have been opposing efforts to open up the ASEAN travel market. The main concern lies on the competition threat from stronger carriers, principally carriers from Singapore, Malaysia, and Thailand, whom they fear will dominate the international market between Indonesia and these countries (IndII, 2012). INACA proposes that liberalization is better pursued bilaterally and selectively according to market need. Open skies approach in the region is considered unnecessary because bilateral air service agreements with all member states suffice the need for all Indonesian carrier operation

(INACA, 2010). Such approach is clearly inconsistent with what have been stated in the multilateral agreements and the overall idea of single aviation market.

This dynamics thereby have led the Indonesian government to ratify only five designated points for open skies. This stand however will open up a sizeable amount of the international market into and out of Indonesia, given that the five cities (particularly the capital, Jakarta) account for the bulk of international traffic into the country. One notable concern is that majority of airports in the five cities is currently facing capacity constraint (see Table 4.15).

In summary, Indonesia shows its efforts to move towards open skies in incremental fashion. Indonesia is more likely to accept staged, rather than rapid, liberalization as it gives government and airline sector more time to adjust to the new level of competition.

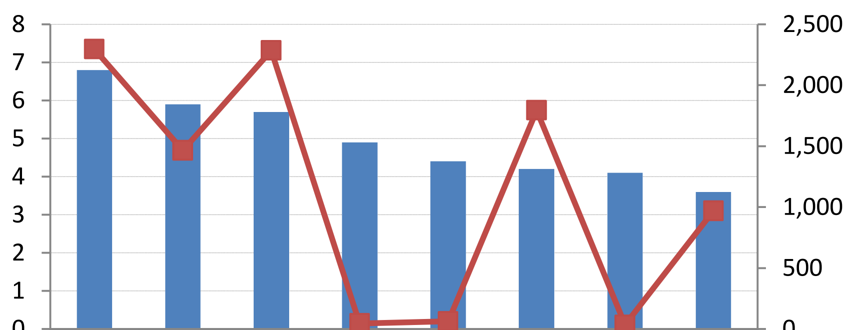
4.4.4 CHALLENGES AND OPPORTUNITIES FOR INDONESIA

Indonesia, however, in the near future will face increasing pressure from its neighbors since it is currently the only most resistant member state to open its market (Bellman, 2013). Cases studies in the past have suggested that open skies can bring economic benefits. The net effects may vary across markets, but there are some common effects (see Oum et al., 2009): (1) increased competition, reduced airfare and traffic stimulation, (2) productive efficiency improvement in airlines, and (3) increasing employment. Indonesia Infrastructure Initiative (IndII) estimates that ASAM implementation will account to around 299 million USD in additional direct Gross Domestic Product (GDP) and an additional 16,000 direct jobs in Indonesia in 2025. If indirect and induced impacts are included, the differentials will increase to around 650 million USD and 29,000 jobs in 2025 (IndII, 2012).

To gain these promising economic benefits, several challenges need to be overcome. Challenges and opportunities that Indonesia is facing toward open skies are identified in this study, related to what has been described in previous section.

1. Airport Infrastructures

Airport infrastructures pose the main challenge to the Indonesia's air transport industry. Expansion projects to increase airport capacities have been commenced, however the current efforts are considered insufficient to keep up with the growth, as shown in Table 4.15. The quality of Indonesia's airports lags behind majority of ASEAN member states, based on World Economic Forum Global Competitiveness Report (see Figure 4.7). On the other hand, Indonesia has relatively high demand of passenger air travel, reflected in the high number of available seat kilometer (ASK). Airport infrastructure quality in Indonesia varies across provinces, ranging from Class I (the highest) to Class V (the lowest). Air transport passenger services are concentrated in western region; the airports in western region are mostly classified as Class III or above. Meanwhile, airports in eastern region, especially in Papua and neighboring Maluku, are mostly classified as Class IV or below (Pisu, 2010).



	SIN	MLY	THI	BRN	CMD	IND	VNM	PHL
Quality of air transport infrastructure	6.8	5.9	5.7	4.9	4.4	4.2	4.1	3.6
ASK/week (millions)	2295.9	1465.8	2286.1	46.6	63.1	1794.9	35.5	970.2

Note. The highest index is 7. Lao PDR and Myanmar are not included.
Source: WEF Index (2012-2013)

Figure 4.7 Comparison of quality of air transport infrastructure and ASK

Further expansions are needed to improve capacity and quality of airports, both for major airports in western region and minor airports in eastern region. These expansions are generally capital-intensive, and airports cannot rely solely on government fund. Under Law No. 1/2009, private companies are allowed to manage and invest in airports. Cooperation/partnership with private parties in airport sector is encouraged by the government through specific mechanisms, such as built-operate-transfer, built-operate-own, contract management, and initial public offerings. However, airport infrastructure in Indonesia is included on ‘negative investment list’, which limits foreign involvement in areas deemed sensitive. Under the regulations foreign investment is limited to owning no more than 49% of domestic airports.

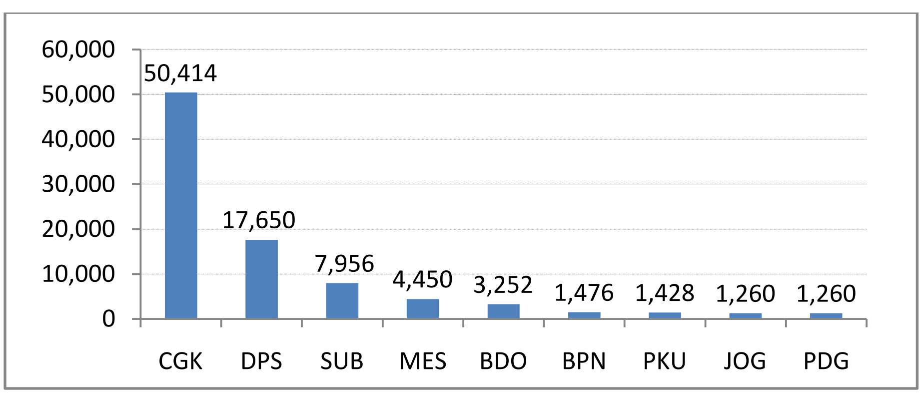
Airline industry has responded to this issue by offering cooperation to airport, for example airline group Lion announced its plan to cooperate with airport operator Angkasa Pura I to develop facilities in five airports: in Batam, Biak, Lombok, Manado, and Makassar (Jakarta Post, 2012). The cooperation includes constructing hangar and aircraft maintenance facilities. This airline-airport cooperation practice is beneficial for both parties as it helps airports to improve facilities, as well as for Lion to strengthen its network. Ministry of State Enterprises recently encourages airline-airport cooperation, specifically between the flag airline Garuda Indonesia and Angkasa Pura (Cakti and Chevny, 2013).

This issue is particularly relevant within the broader issue of airline-airport cooperation in this study. In this regard, liberalization in ASEAN allows more market access rights, which thus encourage airline to expand flight services. Since airport hold the capacity to supply infrastructures (e.g., landing slot, terminal building, etc) for airline to conduct of flight services, close cooperation between airline and airport is deemed necessary, as the case in Indonesia airline-airport industries. Liberalization in Southeast Asia region, albeit limited both in concept and in implementation, may also trigger cooperation between airline and airport.

2. Opening secondary points

Airports with highest passenger throughputs are mostly located in western and central region. Based on data from Ministry of Transportation, it is reviewed that more than 70% of all passengers fly into or out of Soekarno-Hatta airport. Indonesian government also currently opts to open only five major airports for open skies. The network of air transport in Indonesia is thus imbalance, especially for the eastern region which is lagging behind. There is an opportunity to funnel passengers through alternate hubs. Regional secondary bases are necessary given the capacity constraints at major airports such as Jakarta and Surabaya, and also because Indonesia's economic growth is spreading to smaller cities, opening up new opportunities for growth outside the main hubs. Several Indonesian airlines have planned to expand their networks to smaller cities, for example Garuda Indonesia plans to develop secondary hubs as part of its Quantum Leap program.

Links to ASEAN cities from Indonesia still relies heavily through primary airports. For example, Changi Airport in Singapore connects largely through Jakarta, Denpasar, and Surabaya (see Figure 4.8). In 2012, Changi Airport cooperated with local authority in South Sulawesi to increase air traffic between Makassar and Singapore through joint marketing campaign (Endah, 2012). Makassar is planned to serve as hub for eastern region. The annual traffic in Makassar Airport is reported increased 12.69% from 5.5 million in 2011 to 6.3 million in 2012 (CAPA, 2013b). There are other underserved secondary points in Indonesia that would be best linked into a hub type connecting network. Traditionally, the emphasis was on capital cities to provide gateway to Indonesia domestic hinterlands, but now with open skies policy there is opportunity to be more dependent on secondary cities to provide international connection.



Note: CGK = Jakarta, DPS = Denpasar, SUB = Surabaya, MES = Medan, BDO = Bandung, BPN = Balikpapan, PKU = Pekanbaru, JOG = Jogjakarta, PDG = Padang.
Source: CAPA

Figure 4.8 Weekly seats between Singapore and cities in Indonesia (March 2013)

3. External relations with third countries

Cooperation between ASEAN member states with third countries are arranged under 'ASEAN-plus' approach. This approach is essentially an agreement between the member states on the one hand, and the third country on the other. ASEAN and China signed air transport agreement with two protocols: (i) Protocol 1 (signed in 2011) covers unlimited third and fourth freedom traffic rights between any points in contracting parties; (ii) Protocol 2 (signed in 2012) covers fifth freedom traffic rights between 28 secondary points in China and 10 secondary points in ASEAN. Indonesia includes Mataram Airport in the agreement. Under Protocol 2, Indonesian carriers will be allowed to transit to one of other nine opened airports in ASEAN before flying to any of the 28 airports in China. For example, an Indonesian carrier can serve Mataram to Kinabalu, and then take passengers from Kinabalu to continue to a point in China.

This agreement seems lucrative for ASEAN airlines as they can fly unlimited flights to any Chinese point (subject to slot restrictions in congested airports such as Beijing). However, this may create network unbalance as ASEAN airlines can fly to China only originally from points in their own territory, while China can connect any point in their domestic hinterland with any point in ASEAN. To fly directly from other points in ASEAN would require the grant of seventh freedom among member states; however this is out of 2015 single aviation market agreement.

Moreover, agreement with third countries limited to third and fourth freedom may duplicate existing open bilateral agreement. Indonesia already has open bilateral agreements with US and EU, as explained in previous section. Indonesia also has bilateral agreement covering third and fourth freedom with other major countries such as China, India, and Australia (see Table 4.18).

ASEAN's arrangements with external partners are important to the economies of the region. Of the 5.21 million weekly seats operated internationally into and out of member states, 52.3% relate to intra-ASEAN routes and the other 47.2% to markets outside the region. The East Asia countries represent the most significant opportunity for ASEAN, as reflected by the extensive trade and aviation ties between the region and China, Japan, and South Korea (Thomas et al., 2008). This particular challenge pertains not only for Indonesia, but also for other member states.

Table 4.18 Bilateral agreements between ASEAN member states and third country

Countries	No of ASAs	Bilateral agreement				Horizontal Agreement
		Australia	US	China	India	EU
Brunei	36	Yes	Yes (1997)	Yes	Yes	No
Cambodia	12	No	No	Yes	Yes	No
Indonesia	65	Yes	Yes (2004)	Yes	Yes	Yes (2011)
Lao PDR	14	No	Yes (2008)	Yes	No	No
Malaysia	82	Yes	Yes (1997)	Yes	Yes	Yes (2007)
Myanmar	45	Yes	No	No	Yes	No
Philippines	57	Yes	Yes (1995)	Yes	Yes	No
Singapore	>100	Yes	Yes (1997)	Yes	Yes	Yes (2006)
Thailand	94	Yes	Yes (2005)	Yes	Yes	No
Vietnam	56	Yes	Yes (2004)	Yes	Yes	Yes (2006)

Source: US Open Sky Partners, EU Air Transport Agreement, China Air Service Cooperation, India Bilateral Air Service Agreements, Australia Air Service Agreements, as of January 2013. No of ASAs as of August 2011.

Based on overview of Indonesia's development in aviation policy, airline and airport sectors related to air passenger services, it is concluded that Indonesia's aviation policy and industry has evolved from restrictive into a more dynamic market-oriented, although majority of power still relies on government. Indonesia has shown its intention to move towards open skies policy, albeit in incremental fashion.

There are several opportunities identified that can be sought to pave the way toward open skies, namely improving airport infrastructure, opening secondary cities as alternative hubs, and pursuing more external relations between ASEAN and third countries. Infrastructure capacity and quality remain as the main challenge for Indonesia in this matter.

Liberalization in Southeast Asia region, albeit limited both in concept and in implementation, may also trigger cooperation between airline and airport. As for Indonesia, cooperation between airline and airport most likely will occur related with capacity and quality assurances of airport infrastructure. This cooperation is potentially needed to support the expansion of airlines, so that airlines can make use of the market access rights provided by single aviation market in ASEAN.

4.5 Conclusions and Findings

This chapter aimed to analyze air transport liberalization process in Southeast Asia countries. The liberalization agreements and current ratification status were analyzed. Several noteworthy findings are concluded as follows.

Progressive road to liberalization. Member states in ASEAN are on studious path to implement open skies policy. The process toward open skies is done progressively, started back in 1995 and has yielded into two multilateral agreements: MAAS (in 2009) and MAFLPAS (in 2010). The two multilateral agreements ultimately provide unlimited third, fourth, and fifth freedom to all international airports across ASEAN, which is targeted to be effectively enforced by 2015. Foreign ownership limitation on airline industry within ASEAN is aimed to be relaxed based on principal place of business.

Limitation in concept. The term ‘open’ is a relative statement. Based on the multilateral agreements among ASEAN member states, the market are more liberalized and open than previously but it is only accentuated on the international airports. The domestic sector remains regulated. This is not a ‘single market’ in its purest translation as there is clear demarcation between domestic and international sectors. Open skies policy in ASEAN is more restrictive compared to open skies policy in other region such as in EU. There is also the absence of a unified single regulator and each member state retains full regulatory control.

Limitation in practice. The agreements need to be ratified by the member states to be effectively in force. Three member states, Cambodia, Laos, and Indonesia, have not yet ratified the agreements and protocols regarding the market access rights (i.e., unlimited third, fourth, fifth freedom in all international airports). Indonesia is assessed as the most resistant member states regarding the implementation of open skies policy in ASEAN, most likely due to market imbalance (Forsyth et al., 2006; Tan, 2010). Indonesia is more likely to accept staged, rather than rapid, liberalization as it gives airline and airport sectors more time to adjust. Indonesia’s aviation policy and industry has evolved from restrictive into a more dynamic market-oriented, although majority of power still relies on government. There are several opportunities identified for Indonesia to pave its way toward open skies, namely improving airport infrastructure, opening secondary cities as alternative hubs, and pursuing more external relations between ASEAN and third countries. Infrastructure capacity and quality remain as the main challenge for Indonesia in this matter. Further, regarding airline ownership, substantial ownership and effective control principle are still embedded in designated state. Majority of member states retain foreign ownership in airline companies to 40 - 49% limit. Given this ownership restriction, airline companies could extend their networks and enter new regional market only through joint-venture or subsidiary arrangements. This is what has been applied by low-cost carriers in the region such as AirAsia, Lion Air, Jetstar, and Tigerair.

Liberalization is indeed a process full of disagreements and bargaining even for countries who share common values and objectives. Governments seldom approve substantial regulatory changes all at once. Instead, liberalization process in many regions is usually progressive – governments progressively remove restrictions or increase the limit of destinations and number of airlines into market. Like most international treaties, progressive liberalization of air travel has been guided under the principle of achieving reciprocal fairness instead of maximizing social welfare.

Traffic growth. Despite the limitations in concept and implementation of ASEAN open skies, the region has already seen a significant traffic growth. There has been a significant increase in number of flight frequency offered by airlines in most of the routes within Southeast Asia, and the traffic growth is driven by increasing economy and booming low-cost sector. This gives passengers increased routes and services levels as well as lower fares than were typically available prior deregulation and liberalization.

Imbalance between developed and developing countries. In ASEAN, there is a wide divergence of levels of economic development, tourism, and trade performance, and levels of efficiency and productivity of airlines. The state of air transport infrastructure also contributes to the disparity in air links among ASEAN. Some member states such have strong advantage over others. It is possible for open skies to favor the larger aviation power by providing them with more opportunity. The hypothesis is that the least developed countries would be more reluctant toward liberalization (based on GDP per capita, the least developed countries in ASEAN are Vietnam, Laos, Myanmar, and Cambodia). However, looking at the real practice and ratification status, while Cambodia and Laos have not yet ratified all the agreements, Vietnam and Myanmar are keen to open up their markets and have ratified all agreements and protocols. Reluctance is considered more apparent in countries with big number of international points, such as in Indonesia and Philippines. Nonetheless, there were some efforts to equalize the disparity by doing sub-regional groupings such as the BIMP-EAGA (Brunei, Indonesia, Malaysia, and Philippines) and CLMV (Cambodia, Laos, Myanmar, and Vietnam) (Table 4.2), to ensure that countries with similar economic and aviation strength help each other. A progressive transition to an open skies policy in ASEAN allows the smaller countries to establish the needed growth and improvement for the competition.

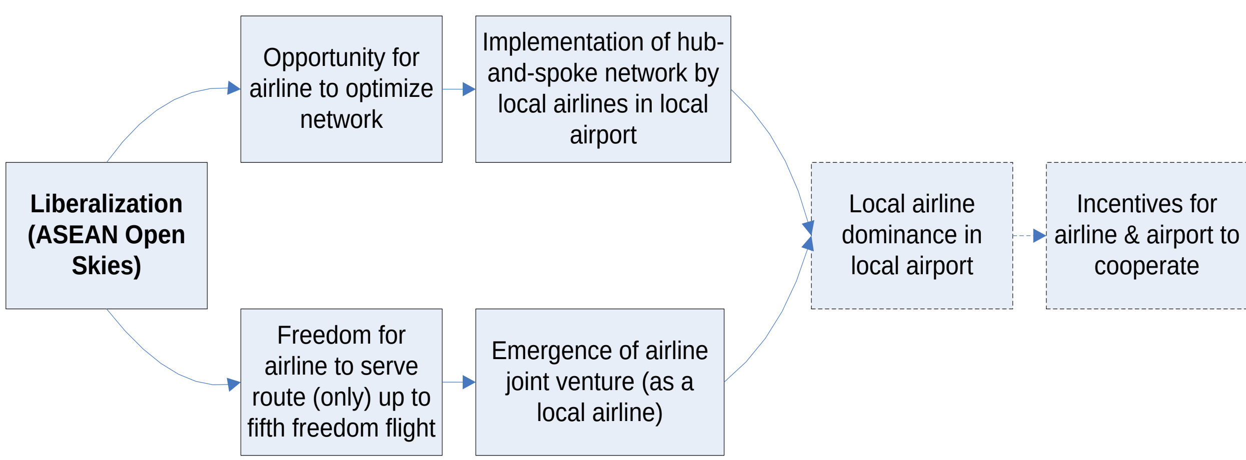


Figure 4.9 Liberalization and airline-airport cooperation in ASEAN: A premise

Airline-airport cooperation. Air transport liberalization in Southeast Asia region, albeit limited in concept and in implementation, may provide incentive (motivation) for airline and airport to cooperate. A premise is presented in Figure 4.9. Again, liberalization under ASEAN Open Skies only allows up to fifth freedom of flight and there is foreign ownership regulation enforced by each member state. This circumstance limits the optimization of airline's network within the local network; airline can take advantage of economy of scope and density, implement hub-and-spoke network only in each origin country's market. This has triggered airline to establish joint venture with local partner (to create local airline) so that the airline can expand network and enter new regional market. AirAsia Malaysia, for example, is not able to implement hub-and-spoke network from an airport in Indonesia. Indonesia AirAsia (that is accounted as Indonesian low-cost carrier), however, can set up base and create hub-and-spoke network from airports in Indonesia. Practices of airline-airport cooperation in Southeast Asia are reviewed in more details in Chapter five.

Chapter 5
Airline-Airport Cooperation in Southeast Asia: Practices and Policy Implications

5.1 INTRODUCTION

Thus far, airline-airport cooperation issues under liberalization were clarified. It was reviewed in Chapter two, how liberalization has helped transforming the traditional relationship between airline and airport into a cooperative relationship. It was also shown, through airline-airport cooperation model under commercial revenue sharing agreement, that cooperation may favor airline dominancy and increase profit of the firms involved but may negatively affect downstream competition between airlines. Chapter four analyzed the air transport liberalization policy in Southeast Asia. It was found that liberalization policy under ASEAN Open Skies (i.e., ASEAN Single Aviation Market) is still limited both in concept and implementation. The liberalization policy is accentuated on unlimited third, fourth, and fifth freedom flight, with progressive implementation from the member states. Liberalization, albeit limited, may also provide motivation (incentive) for airlines and airports to cooperate together. This chapter addresses this issue.

This chapter analyzes practices of airline-airport cooperation in Southeast Asia and the policy implications. First, characteristic of airports in terms of ownership, revenue source, intensity of airport competition, and low-cost carrier share are reviewed. Next, practices of airline-airport cooperation (airport incentive scheme, airline investment on airport facilities, and transit incentive program) are analyzed by using multiple case studies approach. Factors affecting the prevalence of incentive scheme are also analyzed. Finally, policy implications are drawn and competition laws in ASEAN member states are reviewed. This chapter tackled the third objective of this study.

5.2 CHARACTERISTICS OF AIRPORTS IN SOUTHEAST ASIA

This section aims to examine airports in Southeast Asia in four attributes: ownership, revenue source (commercial and aeronautical revenue), degree of competition, and low-cost carrier share. These four attributes or characteristic may shape the attitude of airport toward airlines, which in turn influence the relationship between the airport and the airlines.

1. Ownership

Majority of commercial airport in Southeast Asia are owned by the government. It has been claimed that Asia, especially Southeast Asia, lags behind the rest of the world in the privatization of airports; although private sector has started to be involved in the upgrading of existing airports, governments in Southeast Asia still retain majority control and airports remain high on the agenda of public policy (Hooper, 2002).

Generally there is a single government company that is responsible to manage and operate all airports in each country in the region (see Table 5.1), with Malaysia and Cambodia as the exceptions as their airports are operated by private companies. Malaysia Airport Holdings Berhad (MAHB) was incorporated as a public limited company in 1999 and was thereafter listed on the Kuala Lumpur stock exchange, thus owned by private parties in majority. MAHB is the first airport operating company to be listed in Asia and the sixth in the world. Cambodia Airports holds the concession for the development and the management of Cambodia’s three international airports (Phnom Penh, Siem Reap, Sihanoukville). The shareholders of Cambodia Airports are France’s group VINCI (70%) and Muhibbah Masteron Cambodia (30%), a Malaysian-Cambodian joint venture. In the case of Vietnam, Philippines, Myanmar, Laos, and Brunei, their airports are managed and operated by the aviation authorities. Their aviation authorities thus have roles both as regulator and airport operator.

Ownership reflects the level of commercialization of the airports. One of the intuitive references is the airports with certain level of private ownership would be more willing to take the initiative to develop relationship and cooperate with airlines (Lin et al., 2013).

Table 5.1 Major airport operators

Country	Major airport operator	Ownership	No. of airports operated
Indonesia	Angkasa Pura I, Angkasa Pura II	100% Government	26 (out of 234)
Myanmar	Department of Civil Aviation, Myanmar	100% Government	25 (out of 25)
Vietnam	Airports Corporation of Vietnam	100% Government	24 (out of 24)
Laos	Department of Civil Aviation, Laos	100% Government	14 (out of 14)
Brunei	Department of Civil Aviation, Brunei	100% Government	1 (out of 1)
Singapore	Changi Airport Group	100% Government	2 (out of 2)
Philippines	Civil Aviation Authority of Philippines	100% Government	85
Thailand	Airports of Thailand	Government-majority	6 (out of 64)
Cambodia	Cambodia Airports	Private-majority	3 (out of 17)
Malaysia	Malaysia Airport Holdings Berhad	Private-majority	39 (out of 58)

Source: airport operator websites

2. Competition

The intensity of competition among airports depends on how interchangeable they are for airlines. The variables that determine their substitution are: geographical location, costs, and capacity of facilities (Serebrisky and Presso, 2002). Airports in Southeast Asia may have relatively lower degree of competition compared to airports in other regions such as in EU. Most of the airports are geographically far from each other so that the serve different catchment area. Moreover, airports are owned and operated under the same companies or government authorities, therefore are not likely positioned as competitor even if they are located relatively near. For instance, airports in Yogyakarta (JOG), Solo (SOC), and Semarang (SRG) are all located in Central Java with approximately 100 km distance between them and thus potentially have overlapping catchment area. However, in practice these airports do not establish any strategies to outdo each other since all the incomes of the airports are accumulated to Angkasa Pura I.

In addition to that, there is small number of secondary airports in Southeast Asia (Zhang et al., 2008), that can be considered as the competitor of the primary airports. Clark Airport, for instance, is positioned as an alternative rather than competitor airport to Ninoy Aquino Airport. Clark Airport is needed to ease congestion in the main airport (Tan, 2009).

Another case is Senai Airport (JHB), a secondary airport serving Johor Bahru, Malaysia that is located around 67 km from Changi Airport (SIN) in Singapore. The airport is operated by Senai Airport Terminal Services, a separate state-owned company from MAHB. Government of Malaysia plans to propose twin-project with Changi Airport, where Senai Airport supplies capacity for regional and medium-haul services segment to complement long-haul flight segment in Changi Airport (Musa, 2013). Public railway company, Causeway Link, has been cooperating with AirAsia that fly from Senai Airport, in order to provide shuttle service between Singapore and Senai airport (as shown in AirAsia website). Senai Airport is however too small of capacity to be considered as a direct competitor for Changi Airport.

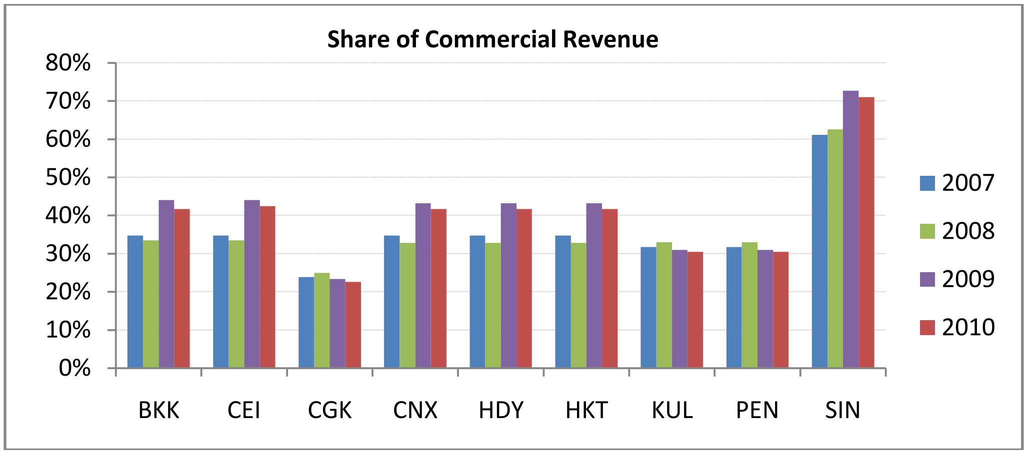
Nonetheless, a competition exists among the primary airports in the region namely among Changi Airport, Kuala Lumpur Airport, and Suvarnabhumi Airport as these airports aim to be the main hub for Southeast Asia to accommodate international long-haul flights. As shown previously in Table 4.8, these three airports have higher percentage of international than domestic passengers. The intensity of airport competition may impact the airport's approach toward airlines. For example, an airport which is facing the competition from a nearby airport may be considered to be more willing to cooperate with airlines.

Source: Google map

Figure 5.1 Location of Senai, Changi, Yogyakarta, Semarang, and Solo airports

3. Revenue source

Airports in Southeast Asia generally depend on aeronautical than on commercial revenue, as shown in Figures 5.2 and 5.3. This is different from the global trend where the contribution of commercial revenue to total revenue in Asia Pacific and European airports have been more significant and increasing from 2007 to 2010 (revisit Figure 3.2). This may relate to the public (government) ownership of airports, they may focus more on the responsibility as a public utility sector rather than on profit making (Humphreys, 1999; Graham, 2008). Changi Airport is the exception since it generates an average of 67% share of commercial to total revenue.



Source: ATRS Benchmarking Report 2012

Figure 5.2 Share of commercial revenue in selected airports in Southeast Asia

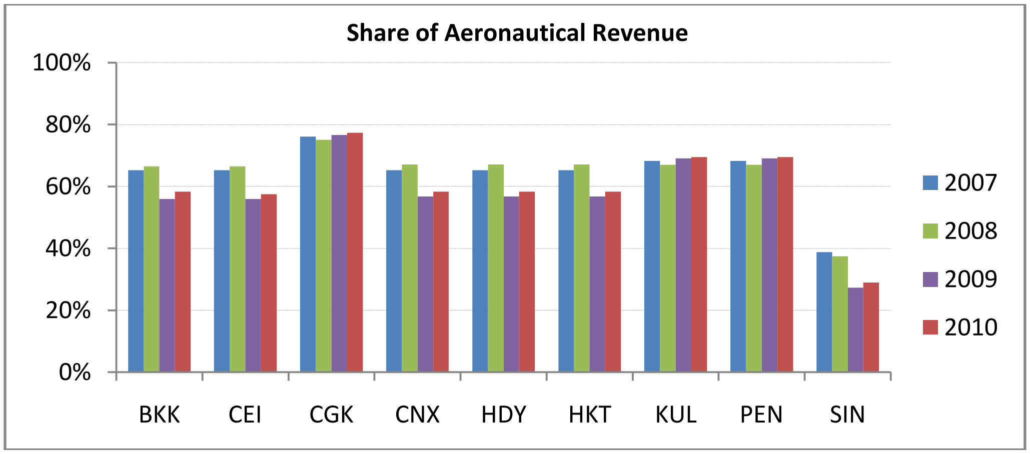
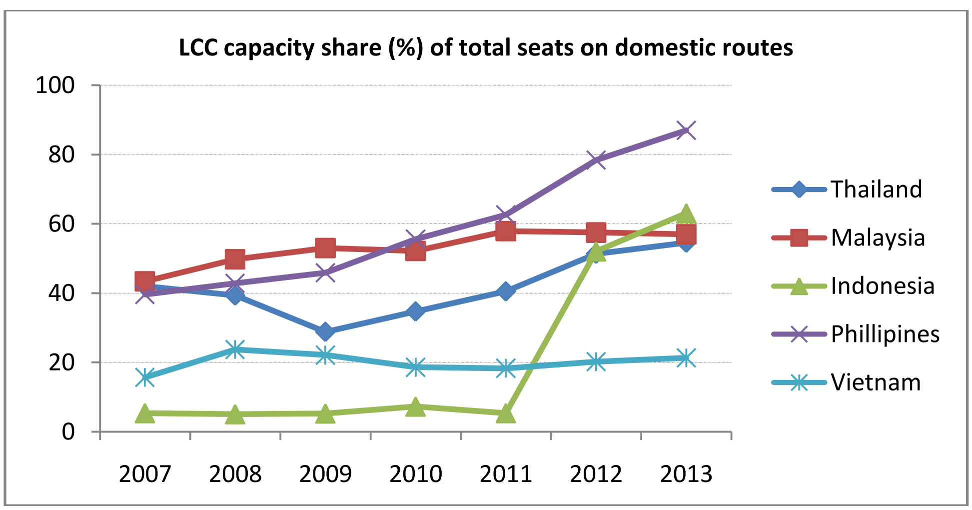


Figure 5.3 Share of aeronautical revenue in selected airports in Southeast Asia

4. Low-cost carrier share

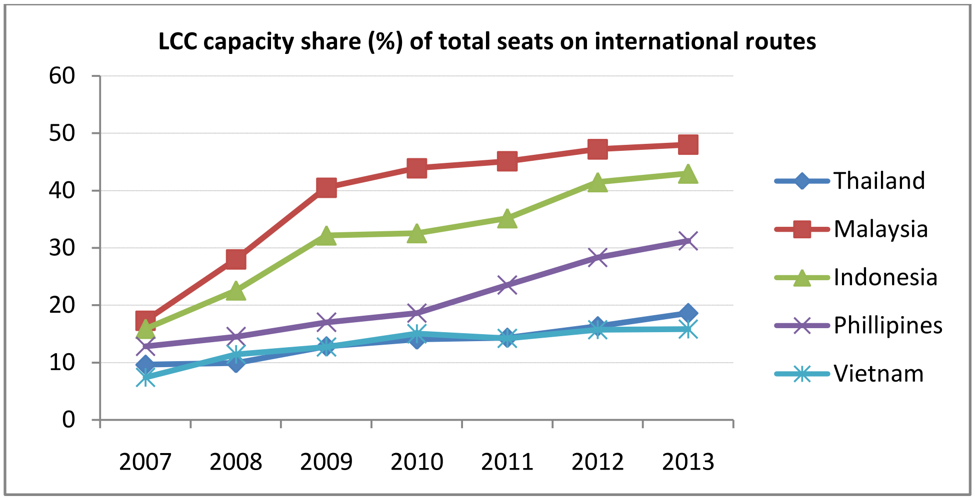
Low-cost carriers have been given rights to operate many international routes due to ongoing liberalization and also due to deregulation of most domestic routes within each country in Southeast Asia. The market share of high demand international and domestic routes is divided to both low-cost and full-service airlines. Low-cost carriers have been increasing capacity and expanding network in the region, ASEAN is the region with highest seat capacities in the world in low-cost carriers sector (CAPA, 2013a). One of the possible reasons is that most intra-ASEAN flights are less than 3000 kilometers and is likely to be operated by B737 or A320 – single-aisle aircrafts utilized by the low-cost carriers.

Southeast Asia's international market has grown by about 20% over the last 18 months from about 4.7 million weekly seats in April 2012 to 5.6 million weekly seats in October 2013, according to Innovata data. The Philippines domestic market has the highest low-cost carrier penetration rate, at nearly 90% at the end of October 2013 (Figure 5.4). Malaysia and Indonesia have the highest international low-cost carrier penetration rates – approaching 50% of total seats (Figure 5.5).



Source: CAPA

Figure 5.4 Low-cost carrier capacity share on domestic routes



Source: CAPA

Figure 5.5 Low-cost carrier capacity share on international routes

In summary, majority of airports in Southeast Asia are owned and operated by single company or government authority. There is small degree of competition among these airports. Airports focus more on aeronautical rather than commercial activities. Further, airports in Southeast Asia potentially have high traffic from low-cost carriers.

As mentioned above, intensity of competition and ownership characteristics of an airport may shape its attitude toward airlines as its customers. Share of commercial revenue and low-cost carrier traffic in an airport may also shape its attitude toward airlines. One of the intuitive references is the airports which are able to earn commercial revenue might be more willing to cooperate with airlines, especially with low-cost carrier (Lei and Papathedorou, 2010), as number of passengers have a significant impact on commercial revenue. Low-cost carrier passengers have been observed to utilize more commercial facilities (e.g., concession, restaurant, etc.) than full-service passenger and thus generate higher commercial income per passenger for airport (see for example Francis et al, 2003).

By observing these characteristics, they give preliminary knowledge on how relationship between airline and airport in Southeast Asia occurs. This real practice of airline-airport cooperation is further clarified in the Section 5.3.

5.3 Airline-airport Cooperation Practices in Southeast Asia

This study attempts to do comprehensive review on cooperation practices that entail financial ties between airlines and international airports in Southeast Asia. Information on airline-airport cooperation is gathered from primary and a variety of secondary sources such as airport websites, newspaper articles, and reports. Interviews were conducted with Indonesian airport operator and airline counterparts. Online archives of at least one national newspaper per country were screened for combinations of several keywords (e.g., airport, airline, government, contract, cooperation, agreement, incentive, discount, and negotiation). However, agreements that were not discussed in public might still have been missed. The practices discovered here can only serve as a lower bound of the actual prevalence of airline-airport cooperation agreements, as the presence of an agreement is often not disclosed officially. Three forms of cooperation are found: airport financial incentive scheme on route and traffic development, airline investment on airport facilities, and transit incentive scheme.

5.3.1 Airport Incentive Scheme on Route and Traffic Development

As explained briefly in Chapter two, airport incentive scheme on route and traffic development is a form of cooperation where airport grants financial incentives to airlines for every new route or additional flights offered. Airports use reductions in the charges (rebates or discounts) as financial incentives for airlines to increase traffic and to develop new routes. Airport incentive scheme on route development is the most common form of cooperation and this practice is prevalent in six member states in Southeast Asia.

Although the importance of commercial revenues for airports has increased significantly (Graham, 2009), aeronautical charges still have significant impact for many airports. Especially in Southeast Asia airports that rely more on aeronautical rather than commercial revenue, incentives within the aeronautical charging scheme might be sufficient to influence airlines' decisions. Fichert and Klophaus (2011) identify several possible objectives of incentive scheme:

1. For underutilized airports the implementation of an incentive scheme might be part of a loss-minimizing strategy, aiming at an increase in traffic and revenues.
2. At airports which are facing a capacity constraint, incentive schemes might focus on traffic mix rather than traffic volume. For example, the airport might wish to increase the share of high-yield customers, especially business or long-haul passengers.
3. For privately owned airports, the economic rationale of applying an incentive scheme also depends on the regulatory environment. Within a single-till cost-plus or rate-of-return regulation, the incentives for growth oriented charging schemes might be limited. On the other hand, under a dual-till regime, increasing the number of passengers could possibly lead to higher profits in the unregulated non-aviation business.
4. For public airports, it might also be important to improve the connectivity of the airport in order to enhance the economic attractiveness of the surrounding region.
5. Incentives might be used by airports that are particularly interested in stable and more reliable traffic development who prefer the establishment or expansion of an airline's base to footloose services which might easily be moved to some other airports.

The options of incentive scheme are wide-ranging. Type of incentives can be categorized into two: (i) incentives within established charging system (such as reduction on landing charges, passenger charges and transit passenger charges); and (ii) separate incentives (such as based on annual traffic volumes or based on growth). Incentives can be also be given as a published scheme (apply to all airlines) or as a bilateral negotiation (customized per airline).

Fifty-one international airports in six countries in Southeast Asia are assessed. Soekarno-Hatta Airport in Indonesia is the biggest airport in the sample (57.7 million passengers in 2012), and Sihanoukville Airport in Cambodia is the smallest (13.8 thousand passengers in 2012). One-third of the airports analyzed (34 of 51) have introduced airport incentive schemes. Only two cases of bilateral negotiation incentive scheme are found. No evidences of incentive program can be found at Philippines, Vietnam, Laos, and Myanmar airports (Table 5.3). The lack of evidence does not imply that no incentives are offered at all in these countries, but rather that incentive schemes are neither publicly disclosed nor discussed. The Civil Aviation Authority of Vietnam (CAAV) plans to implement open, flexible policies to support the operations by all airlines; incentive schemes will be offered in the near future to airlines operate from Phu Bai, Cam Ranh, Lien Khuong, Can Tho, and Phu Quoc international airports (CAAV, 2013). As for this study, Vietnam airports are excluded from sample set. Table 5.2 reveals the absolute and relative importance of the various incentive schemes according to airport ownership. The results show that the general prevalence of incentives offered overall does not vary substantially between public and private ownership airports. However, the prevalence of incentives tends to vary between airports of different size. While primary, secondary, and tertiary airports predominantly offer incentive scheme, less than half of fourth-tier airports offer the incentive scheme.

Table 5.2 Airport incentive schemes according to airport size and ownership

Airport Type	International Airports	Incentive schemes at airports			
		No. airport with incentive scheme		Incentive program apply equally	Customized per airline
		Absolute	Relative		
According to passenger throughput					
Primary (> 10 M)	8	8	100%	6	1
Secondary (5 - 10 M)	4	4	100%	4	0
Tertiary (2 - 5 M)	16	13	81.3%	12	1
Quaternary (< 2 M)	23	10	43.5%	10	0
Sum	51	35	66.7%	32	2
According to ownership					
Government 100%	28	21	71.4%	18	2
Government majority	10	5	50.0%	5	0
Private majority	13	9	69.2%	9	0
Sum	51	35	66.7%	32	2

Source: incentive scheme from airport specific sources

Table 5.3 Airport incentive schemes according to country

Country	International Airports	Incentive schemes at airports			
		Total		Incentive program apply equally	Customized per airline
		Absolute	Relative		
Indonesia	26	18	76.9%	17	1
Malaysia	11	6	54.5%	6	0
Thailand	10	6	50%	6	0
Cambodia	3	3	100%	3	0
Singapore	1	1	100%	0	1
Brunei	1	1	100%	1	0

Source: incentive scheme from airport specific sources

The next step is to investigate the factors that drive the incentive offering, using data of 51 sample airports in Southeast Asia. The Southeast Asian perspective is regarded as instructive, because of the distinctiveness of airport characteristics from other airports, such as from European airports, in terms of ownership structure, competitive constraint, revenue source, and low-cost carrier capacity share (as has been reviewed in Chapter 5.2). The binary logistic regression model is used to analyze the prevalence of incentive schemes. For what follows, the predictor variables of incentive scheme are explained. Then, the dataset and estimation method are presented. Finally, results are discussed.

1. Predictor (independent) variables

Incentives, whether offered within a published scheme or negotiated bilaterally, aim at attracting additional traffic either in general or with a focus on particular routes and traffic segments. As explained in Section 5.2, several factors such as: ownership structure, revenue source, airport competition, and low-cost carrier capacity share, may affect the attitude and perceptions of an airport management to cooperate with airlines, and in this case cooperation is done through introduction of an incentive scheme. Other factors such as hub status and economic activity in airport's catchment area also potentially affect the perceptions of an airport management. The hypothesis of each predictor variable is explained as follows:

- Airport management may introduce incentive scheme if they believe that the **economic activity in the airport catchment area** is supportive for airlines to provide flight service. Consequently, the presence of an incentive scheme may be positively affected by the economic activity (gdp_i).
- **Hub status** (hub_i) may affect the presence of an incentive scheme at an airport. The direction of the effect can be driven by two conflicting factors. As a hub, an airport may not need additional traffic boost from an incentive scheme since many airlines are naturally willing to serve a hub airport. On the other hand, a hub, especially the one with excess capacity, may want to strengthen its position and increase its destination options so that the airport becomes more appealing for travelers. Therefore, the effect of hub status on the presence of incentive scheme is ambiguous.
- The intensity of **airport competition** ($comp_i$) may affect the airport's approach toward airlines. The direction can be driven by two conflicting factors. On one hand, an airport facing the competition from a nearby airport is considered to be more willing to cooperate with airlines, thus willing to give incentive to airlines in order to mutually help their route and traffic development. On the other hand, airlines may easily shift to another airport once the incentive scheme period is over, thus airport management is less likely to give incentive in the first place. Consequently, the effect of airport competition on the presence of incentive scheme is ambiguous.
- **Ownership structure** (own_i) reflects the level of commercialization of the airports. The intuitive reference is the airports with certain level of private ownership would be more willing to take the initiative to develop relationship and cooperate with airlines, including through introduction of an incentive scheme. On the other hand, government-owned airports may be eager to introduce incentives in return for enhanced economic development through additional air traffic. The effect of ownership structure on the presence of incentive scheme is ambiguous.

- Airports with ability to earn commercial revenue may be more willing to cooperate with airlines, by giving incentive to airlines to induce traffic, as passenger volume has a significant impact on commercial revenue. The **share of airport's commercial revenue** ($comrev_i$) may positively affect the presence of an incentive scheme at that airport.
- Air transport growth in Southeast Asia has been driven largely by low-cost carriers (CAPA, 2013a). Since these airlines follow a low-cost strategy and airport charges might be substantially alter their cost, they consider airport charges as an important determinant of airport choice (Barrett, 2004). Thus, airport manager may regard offering route and traffic incentives as a way to attract to low-cost carriers. This might be especially true if airports try to attract low-cost carriers such as AirAsia, that have history of pushing airport operator to introduce lower landing fees and other costs (Hookway, 2009). The **potential network development of low-cost carriers** (lcc_i) may positively affects the presence of an incentive scheme at an airport.

2. Data set and estimation method

Based on the described factors, relationship between the presence of incentive scheme at airport (IS_i = 1) and predictor variables can be analyzed utilizing logistic regression model, as shown in Equation 5.1.

$$Pr(IS_i = 1) = \theta(x) = \frac{e^{(\alpha + \boldsymbol{\beta}\mathbf{X}_i)}}{1 + e^{(\alpha + \boldsymbol{\beta}\mathbf{X}_i)}} \tag{5.1}$$

where $\alpha + \boldsymbol{\beta}\mathbf{X}_i$ is the linear function of an explanatory variables $\mathbf{X}_i$, and i denotes the airport. The inverse of the logistic function is shown in Equation (5.2):

$$\begin{aligned} g(x) &= \ln \frac{\theta(x)}{1-\theta(x)} \\ &= \alpha + \beta_1(gdp_i) + \beta_2(hub_i) + \beta_3(comp_i) + \beta_4(own_i) + \beta_5(comrev_i) + \beta_6(lcc_i) \end{aligned} \tag{5.2}$$

Thus, we can predict the odds of incentive scheme based on the values of the independent variables (predictors). The odds are defined as the probability of incentive scheme over the probability of non-incentive scheme in an airport. Next, the data set is discussed based on a sample of 51 airports in Southeast Asia. The sample includes 35 airports offering incentive scheme for route and traffic development. The parameterization of predictor variables in Equation (5.2) is explained as follows.

- The potential network development of low-cost carriers is approximated trough the current presence of low-cost carriers at airports. Low-cost carriers may develop network to airport that has *not* yet been served or served with small number of destinations. Since AirAsia is the largest low-cost carriers in Southeast Asia with network covering almost all ten countries in the region, the dummy variable $airasia_i$ is used, denoting the number of destination currently offered by AirAsia at each airport. Airport that has the highest destination offered by AirAsia is Kuala Lumpur Airport.

- Intensity of airport competition ($comp_i$) is quantified by summing inverse driving distances between every airport with other 50 airports in the data set. The driving distance is obtained from Google Maps. Airports that are located near to each other thus get higher intensity value. Five airports with the highest intensity of airport competition are Kuala Lumpur, Subang, Changi-Singapore, Suvarnabhumi, and Don Mueang airports.
- Hub status ($hub_i = 1$) is collected based on airline route map. If an airport is used as a transit airport by an airline, the particular airport is considered as a hub.

- Economic activity in the airport catchment area is approximated through the gross domestic product (GDP) of a province or state. Data are available in the forms of gross domestic per capita and population, thus we multiply both data for each province or state. The logarithmic form of GDP is used for better approximation ($lngdp_i$). Airports with the highest and lowest GDP are Changi-Singapore and Sihanoukville airports, respectively.

- An airport is classified as public-owned (own_i = 1) if the share of public entities in an airport operator company exceeds 50%. However, the airports in the sample set are not heterogeneous in term of ownership structure; 13 out of 51 airports are private-owned while the rest are government-owned airports.
- Data availability on the share of commercial revenue at airports is very limited. We can only gather data on commercial revenue share on nine out of 51 airports. Therefore, there is no other way but to exclude the share of commercial revenue from the explanatory variables. Based on the data of the nine airport (Figure 5.2 and 5.3), we also suspect the airports in the sample set are not heterogeneous in term of revenue source.

A summary of the parameterization and data sources for all variables is presented in Table 5.4 (continuous variables) and Table 5.5 (discrete variables). The complete data set is provided in Appendix. Based on the parameterization and data availability, the inverse logistic function can be re-stated as follows.

$$g(x) = \alpha + \beta_1(\ln gdp_i) + \beta_2(hub_i) + \beta_3(comp_i) + \beta_4(own_i) + \beta_5(airasia_i) \qquad (5.3)$$

Table 5.4 Descriptive statistics of continuous variables

Variable	Parameterization	Source	N	Mean	Std dev.	Min	Max
airasia	Number of destination offered in airport	AirAsia route map	51	6	13	0	83
comp	Distance-weighted airport presence	Google Maps (distance)	51	0.02	0.015	0.001	0.055
gdp	Gross domestic product (GDP, in millions)	Statistic agency	51	19.32	42.49	0.13	274.68
ln gdp	logarithmic of GDP		51	15.77	1.39	11.79	19.43

Source: author

Table 5.5 Descriptive statistics of discrete variables

Variable (X)	Characteristics of airports	No. of airports (N)	No. of airports (X = 1)	No. of airports (X = 0)	Sources
IS	Incentives for route or traffic	51	35	16	Airport-specific sources
hub	Hub status	51	17	34	Airlines' route map
own	Public-owned	51	38	13	Airport-specific sources

Source: author

3. Results

First, we estimate the presence of incentive scheme using five predictor variables. Table 5.6 lists coefficients and standard errors of the variables. Information on the statistical significance is also provided based on the Wald chi-square value and 2-tailed p-value used in testing the null hypothesis that the coefficient of the respective explanatory (independent) variable is 0. It is shown that variables *airasia*, *comp*, and *own* are not statistically significant – the presence of low-cost carriers, the intensity of airport competition, and ownership structure do not seem to affect the presence of incentive scheme at airports; meanwhile, the variables *lngdp* and *hub* are statistically significant at 5%(**) and 10%(*). This result is then confirmed with a new estimation utilizing these two explanatory variables. We obtain better estimation by using two predictor variables *lngdp* and *hub* – economic activity in the catchment area and hub status seem to affect the presence of incentive scheme. The Nagelkerke r-square (pseudo r-square) of model with two explanatory variables is higher (0.466), compared to 0.439 with five explanatory variables, reflecting the improvement in the likelihood value of model with predictors. The percentage of correct prediction is increased from 76% to 78%. Multicollinearity among the independent variables is also considered by doing regression by steps and omitting each time these two variables (*lngdp* and *hub*). Coefficients and standard errors remain with relatively small changes; the multicollinearity effect does not seem too relevant.

Table 5.6 Estimation results with five explanatory variables

Explanatory variables	B Coefficients (Standard Error)	Wald	Sig.
ln(gdp)	0.788** (0.395)	3.985	0.046
hub	2.569* (1.503)	2.921	0.087
airasia	-0.041 (0.038)	1.193	0.275
comp	-24.94 (40.328)	0.382	0.536
own	0.623 (0.878)	0.503	0.478
Constant	-12.107* (6.21)	3.800	0.051

Table 5.7 Estimation results with two explanatory variables

Explanatory variables	B Coefficients (Standard Error)	Wald	Sig.
ln(gdp)	0.626** (0.317)	3.903	0.048
hub	1.919* (1.135)	2.858	0.091
Constant	-9.422* (4.873)	3.781	0.052

The estimation result in Table 5.6 is noteworthy, to be compared with the result of Allroggen et al. (2013). Allroggen et al. (2013) estimate the factors that influence the presence of an incentive scheme at European airports and concluded that: economic activity, potential network development from low-cost carriers, and public status encourage the presence of incentive scheme at airports. Meanwhile, intensity of airport competition discourages the presence of incentive scheme.

The directions of the influence factors regarding the presence of incentives at European airports are similar with our result in the case of Southeast Asian airports (see parameter sign on Table 5.6): (i) probability of the presence of incentive scheme increases for airport with high economic activity (high GDP) in the catchment area; (ii) airports are more likely to offer incentive if they are not yet served by AirAsia; (iii) airports with hub status are more likely to offer incentive; (iv) presence of incentive is more likely if airports are controlled by public entities; and (v) airports are less likely to offer incentive if they face higher competition (there are other airports nearby).

However, despite the similar directions of the influence from five factors, only GDP and hub status that are statistically significant in the case of Southeast Asia airports. Our results suggest that airport operators in Southeast Asia may consider hub status and economic activity in the catchment area when deciding to offer an incentive scheme. It should be noted that the data set used is relatively small (51 airports). If the data set includes more airports, different results can be expected.

Generally, airport management introduce incentive scheme if it is economically viable. Economic viability can assessed based on the projected net present value of the incentives for route and traffic development (Equation 5.4):

$$NPV_{IS,i} = \sum_{t=1}^{I} \frac{\Xi_t}{(1+r)^t} + \sum_{t=I+1}^{\infty} \frac{\Pi_t}{(1+r)^t} \tag{5.4}$$

where r is an airport's discount rate, Ξ_t denotes the projected profits from additional traffic during the application of the incentives, while Π_t denotes projected profits after the expiration of the incentives. Incentive scheme is introduced ($IS_i = 1$) at an airport i if $NPV_{IS,i} > 0$. Incentive is not introduced ($IS_i = 0$) if $NPV_{IS,i} \leq 0$. According to standard index function model, Equation (5.5) thus can be derived, where X_i are the factors that influence the presence of an incentive scheme in an airport.

$$Prob(IS_i = 1 \mid \mathbf{X_i}) = Prob(NPV_{IS,i} > 0 \mid \mathbf{X_i}) \tag{5.5}$$

However, public (government-owned) airports may introduce incentive scheme even though the incentive scheme is not economically viable. Public shareholders potentially cover an airport's losses in return for regional economic development induced through additional air service. From the estimation results provided in Table 5.6, government-owned airport in Southeast Asia is more likely to introduce incentive scheme (coefficient +0.623) than private-owned airport.

In summary, a standard binary logistic regression approach is applied to assess factors that may affect the presence of incentives for route and traffic development in Southeast Asian airports. According to the results, airport is more likely to offer incentive if the economic activity in airport catchment area is high. Hub airport is more likely to offer incentive. The influence of factors such as ownership structure is not observable due to the homogeneity (thus statistically insignificant in the regression); most of the airports in Southeast Asia are operated and owned by the government. Table 5.8 lists the incentive schemes that are observed in 35 airports from 51 sample airports. It is shown that airports offer incentive schemes based on frequency, route, and/or passenger growth.

Table 5.8 Incentive schemes at selected international airports in Southeast Asia

	International Airports	Incentive Schemes
1–2	Bangkok Suvarnabhumi (BKK), Don Mueang (DMK)	Discount on landing fee **based on the increase of international passengers** compared to the previous year. Bonus factor maximum 2.75 for airlines that increase passengers by 20% and above
3	Chiang Rai (CEI)	**New destination**: discount 95% on landing and parking fee and bonus 120 Baht per passenger. **New frequency**: bonus 120 Baht for each passenger increased over previous year
4	Chiang Mai (CNX)	**New destination off-peak**: discount 95% on landing and parking fees and bonus 70 Baht per passenger. **New destination on-peak**: discount 95% on landing and parking fees. **New frequency off-peak**: Bonus 60 Baht for each passenger increased. **New frequency on-peak**: Bonus 40 Baht for each passenger increased
5	Hat Yai (HDY)	**New destination**: discount 95% on landing fee and bonus 120 Baht per passenger. **New frequency**: Bonus 120 Baht for each passenger increased
6	Phuket (HKT)	**New destination off-peak**: discount 95% on landing fee and bonus of 70 Baht per passenger. **New destination on-peak**: discount 95% on landing fee. **New frequency off-peak**: Bonus 60 Baht for each passenger increased. **New frequency on-peak**: 40 Baht for each passenger increased
7–12	Kuala Lumpur (KUL), Kinabalu (BKI), Kuching (KCH), Langkawi (LGK), Penang (PEN), Subang (SZB)	**New destination or frequency**: discount 100% on landing fee. **Bonus based on increase in passenger**, \$3 per passenger for first 10% increase, \$4.2 per passenger for the next 8% and \$5 per passenger for the next 18%
13–14	Phnom Penh (PNH), Siem Reap (REP)	**Regularity incentive**: discount 10% on ground handling fee for 1-year service, 5% for 6-month service. **New destination**: discount 10% on ground handling fee. **New frequency** (minimal 60% load factor): discount rate based on flight frequency
15	Sihanouk (KOS)	**New destination or frequency**: discount 100% on ground handling fee
16	Singapore (SIN)	**Bilateral incentive** (airport growth incentive)
17–21	Surabaya Juanda (SUB), Denpasar (DPS), Solo (SOC), Yogyakarta (JOG), Makassar (UPG)	**New destination or frequency**: discount 30–50% on landing, parking, aerobridge fees
22	Lombok (LOP)	**New destination or frequency**: discount 60% on landing and parking fees
23–24	Manado (MDC), Balikpapan (BPN)	**New destination or frequency**: discount 100% on landing and parking fees
25–33	Jakarta Soekarno-Hatta (CGK), Medan (KNO), Pontianak (PNK), Padang (PDG), Pekanbaru (PKU), Palembang (PLM), Bandung (BDO), Aceh (BTJ), Jambi (DJB)	**New destination or frequency**: discount 25% on landing, parking, aerobridge fees
34	Batam (BTH)	**Bilateral incentive**
35	Brunei (BWN)	**New destination**: discount 100% on landing and parking fees for the 6 months, 50% for the following 6 months, and 25% for the following 1 year. **New frequency**: 50% for first 6 months, 25% on the following 6 months

Introduction of an incentive scheme inevitably affects the relative position of airlines, tensions in the relationship between airport and some of its airline customers are likely to occur. Incentive based on volume growth for example, favor the largest airline at an airport, so they raise some competitive concerns (Fichert and Klophaus, 2011). Moreover, incumbent airlines sometimes complain about the discount for newcomers, or vice versa.

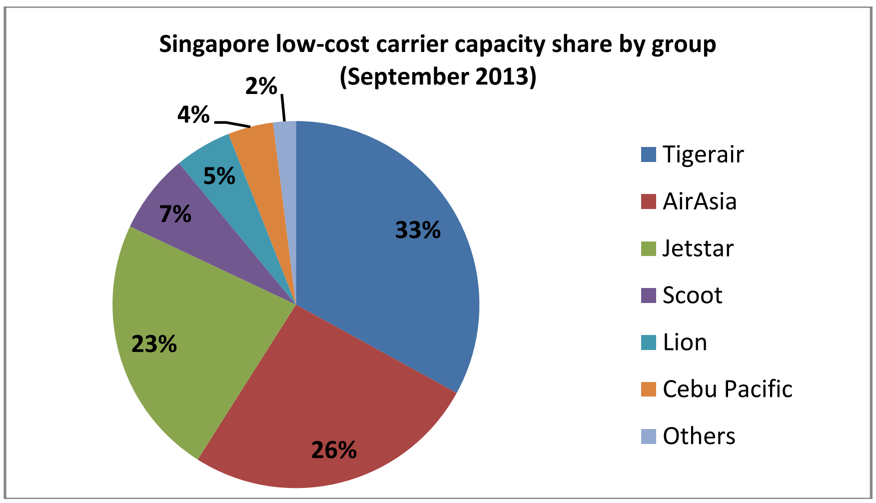
Incentive schemes offered in Southeast Asia airports are based on volume growth, additional frequency and destination (see Table 5.9). If this applies equally for every airline, this is unlikely to create any competitive concerns (FAA, 2010). Nonetheless, there are airports that apply bilateral incentive scheme where the incentive is customized and negotiated per airline, namely Changi Singapore Airport and Batam Airport

- **Changi Singapore Airport**

  Changi Airport Group (CAG) administers an incentive scheme known as the Changi Airport Growth Initiative started from January 2010. The focus of the program is to incentivize airlines and airport partners to grow their traffic volumes at Changi. Chief Executive Officer of CAG, Lee Seow Hiang stated on an interview:

  "With Changi Airport Growth Initiative, we will adopt a far more customized approach by using an effective and optimum mix of targeted and performance-based incentives. We believe that each of our airport partners faces different opportunities and challenges in a rapidly changing aviation environment. The one-size-fit-all approach is less effective and responsive to their needs. Our aim is therefore to work closely with each partner with differentiated measures to spur growth, support innovation and, ultimately, boost Changi Airport's overall competitiveness." (CAG, 2009).

  The incentive scheme is therefore conducted bilaterally and the rate is customized per airline. CAG has signed on Jetstar Group as one of its first partners under the incentive scheme in January 2010 (Yue, 2010). The Jetstar Group, which includes Jetstar Australia, Jetstar Asia and Valuair, bases the A320-family aircrafts at Changi and commits to increase flight frequencies and offer more destinations under three-year agreement started in January 2010. Jetstar also aims to grow the percentage of transit and transfer traffic through Changi among its passengers. The airport supports Jetstar's growth with various incentives that enable them to lower its cost of operations. By having a hub at Changi, Jetstar gain from interlining opportunities with many airlines including its parent, Qantas that already uses Changi as a hub for Asia operation. For the airport, it benefits from the increased number of flights and destinations, which contributes to higher passenger traffic. The partnership is argued to be beneficial for air travelers in the region who can enjoy a greater choice of low-fare travel options. Jetstar is currently the third largest low-cost carrier group operating at Changi with 23% capacity share among other low-cost carriers.



Source: CAPA

Figure 5.6 Singapore low-cost carrier capacity share by group

- **Batam Airport**

Batam Airport is the largest Indonesian airport that is not owned and operated by government-owned Angkasa Pura I or II. The airport is owned by the local Batam government and is in a free trade zone; therefore the authority has autonomy to decide the rate of aeronautical charges, where the charges are cheaper than any other hub airports in Indonesia (CAPA, 2013c). According to interview with the airport's commercial head, incentive is given to the airlines based on negotiation and the rate of the incentive is not publicly disclosed. Batam authority has signed on Lion Group as its partner, where Lion Group has the largest capacity share in the airport (52%, see Figure 5.7). The airport can accommodate 3.3 million passengers annually and currently has excess capacity to accommodate new airlines and new development of maintenance facilities. This issue is further clarified in the next section.

So all-in-all, it is observed that airports in Southeast Asia cooperate with airlines through incentive scheme. Based on survey through primary and secondary sources, 35 out of 51 airports are found to offer incentive to the airlines. Incentives are offered based on volume growth, or additional route and/or flight frequency. Airport operator is more likely to offer incentive for route and traffic development if there is high economic activity in the airport's catchment area. There is higher probability of the presence of incentives at an airport if the airport has hub status. Some airports cooperate more closely with airlines through bilateral incentive scheme where the incentive is customized and negotiated per airline, namely Changi Singapore Airport and Batam Airport. They offer incentive scheme to their airlines, especially to airline that has substantial capacity/market share in each respective airport. Changi offered incentive scheme to Jetstar group (23% capacity share among low-cost carriers), while Batam offered incentive to Lion group (52% capacity share among all airlines). Jetstar and Lion are both low-cost carriers. According to Lin et al. (2013), if low-cost carriers represent 8% or more of total flight operations of an airport, the airlines are considered important to the airport.

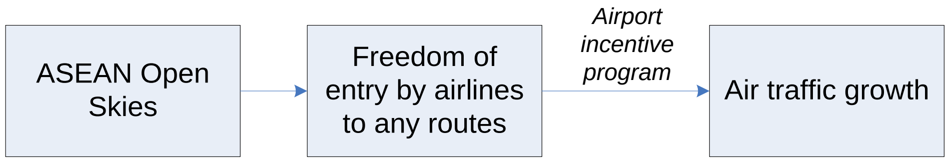


Figure 5.7 Airport incentive program to induce traffic growth

This incentive program is likely being influenced by regional liberalization ASEAN Open Skies (Figure 5.7). For example, in Malaysia, the extension of Airline Incentive Program is part of the 5-year transformation strategy of MAHB (2010-2015) – as preparation for ASEAN Open Skies 2015 (Tham, 2008). The incentive program is intended to attract more foreign airlines to fly into KLIA as well as other international airports managed by the MAHB. Incentive program, however, may not solely be influenced by ASEAN Open Skies, but also by other economic consideration and airport development objective (e.g., aiming for regional hub). Incentive program in Malaysia airports was started in 2007, and Changi and Suvarnabhumi airports started their airport growth initiative programs in 2010.

5.3.2 Airline Investment on Airport Facilities

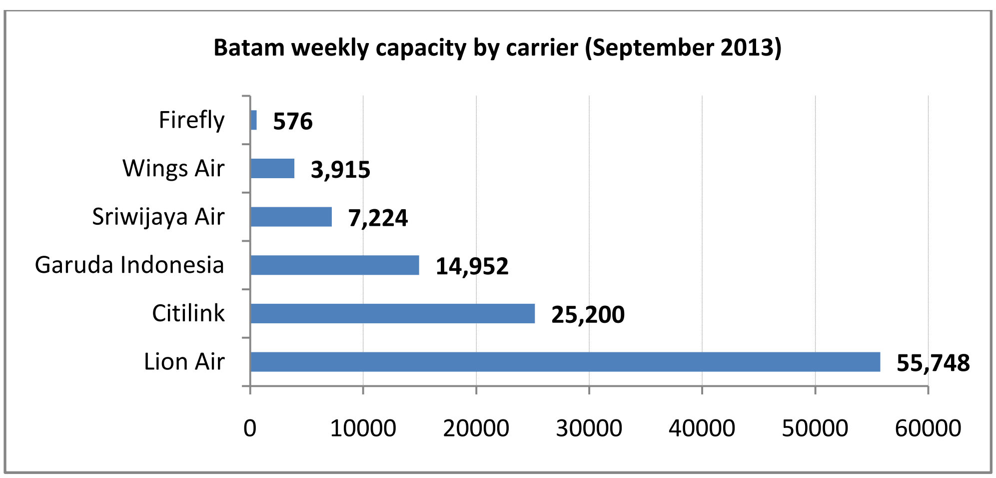
Cooperation that is discussed next is airline investment on airport facilities. This is a form of cooperation where airline owns, partially or completely, terminal or other facilities in airport. Such ownership allows the airline to optimize operations of the facilities, while in return it helps airports to finance the development of airport. Two cases of airline investment on airport facilities in Southeast Asia are found: (1) Lion Group invested on maintenance facilities at Batam Airport, (2) Thai Airways invested on several facilities at Suvarnabhumi Bangkok Airport.

1. Lion and Batam Airport

Lion invested maintenance, repair, and overhaul (MRO) facilities at Batam Airport. The project costs $100 million and requires six-hectare area which can accommodate up to 12 narrow-body aircrafts. Lion Air then closed its previous hangar at Surabaya Airport, and moved its maintenance operations to Batam started from June 2013 (Fadli, 2013).

Lion Air is by far the largest airline at Batam, accounting for about 52% of seat capacity (Figure 5.8). Meanwhile, Batam is the ninth largest hub for Lion. Batam Airport has seen rapid growth over the last year, driven primarily by expansion from Lion, according to Innovata data. Lion has added several routes from Batam, including Semarang on Java and Bengkulu and Jambi on Sumatra. According to interview with the chief representative of Lion for Batam, by establishing a hub at Batam, Lion is able to reduce dependence on the congested Jakarta Soekarno-Hatta: *"Lion's portion of transit traffic at our largest hub, Jakarta Soekarno-Hatta, will be reduced as Batam grows. This will allow us to grow local traffic to and from Jakarta, where demand continues to be robust, without having to secure more slots at Soekarno-Hatta. Sixty-percent of Lion's traffic at Batam is already transit."*

Infrastructure constraints at Soekarno-Hatta limit growth opportunities, forcing airlines to consider alternative hubs. For Lion the need to establish and grow alternative hubs is particularly important as only a relatively small number of aircraft can be based at Soekarno-Hatta given the congestion at Indonesia's largest airport.



Source: CAPA

Figure 5.8 Lion Air as the largest airline at Batam Airport

2. Thai Airways and Suvarnabhumi Airport

Thai Airways has invested six investment facilities in Suvarnabhumi Airport, transferring its services from the previous Don Mueang Airport to the new Suvarnabhumi Airport. The total area of the facilities is approximately 728,850 square meters and the total project costs approximately US$428 million. The development commenced in December 2002 and the construction was completed in October 2005. The investment comprises six facilities: (i) aircraft maintenance center (total area 190,400 square meters); (ii) ground support equipment (total area 127,500 square meters); (iii) catering facilities (capacitates food production of 87,000 sets per day with the total area of 169,450 square meters); (iv) operation center (total area 55,400 square meters); (v) Cargo and mail commercial (including international and domestic cargo terminal, total area 160,100 square meters); (vi) Ground customer services (total area 26,000 square meters). Data were obtained from the Consulting Engineers Association of Thailand (CEAT).

Thai Airways is by far the largest in Suvarnabhumi Airport with 36.25% market share (Figure 5.9). Meanwhile, Suvarnabhumi is the main hub for Thai Airways. Suvarnabhumi handled 52.4 million passengers in FY2012, including 19 million for Thai Airways and 6.4 million for Thai AirAsia, according to CAPA data.

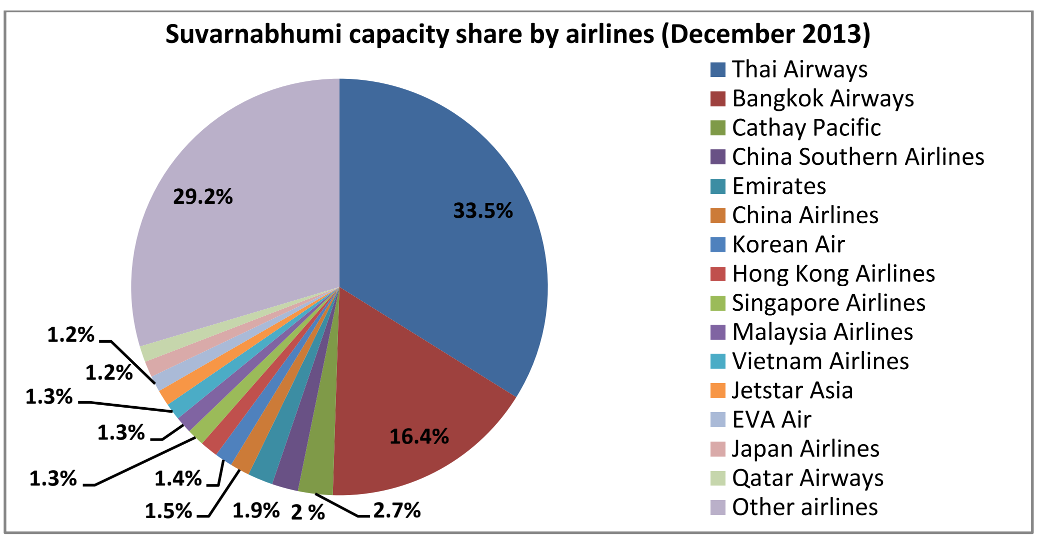


Figure 5.9 Thai Airways as the largest airline at Suvarnabhumi Airport

A pattern is observed in the case studies of Lion Air-Batam Airport and Thai Airways-Suvarnabhumi Airport; we see that airline and airport in each pair heavily depend on each other, thus creates a high mutual dependence. Mutual dependence affects the interactions between interacting parties, where high mutual dependence can promote cohesion of a relationship (Casciaro and Piskorski, 2005; Pfeffer and Salancik, 2003).

Lin et al. (2013) examine how low-cost carriers and airports in Southeast Asia develop their business relationships and the influences of mutual dependence on their interactions through multiple interviews within case studies. It is stated in their study that dependence of airport on airline can be measured based on the proportion of the airline's flight to the total number of flights in the airport. Meanwhile, dependence of airline on airport can be measured based on deployment of the fleet to/from the airport; deployment of an airline's fleet reflects the demand of the route operating to and from the airport. Moreover, dependence of airline on airport can also be measured based on the share of transit passenger at the airport (Oum and Fu, 2008).

In the case of Lion Air-Batam Airport, Batam receives more than half passengers and flights from Lion (52% share) denoting a high dependence of Batam on Lion; whereas Lion has approximately has 60% transit passenger at Batam and put Batam as its ninth hub, denoting a relatively high dependence of Lion on Batam. This gives them motivation to cooperate in the forms of facility investment and bilateral incentive scheme.

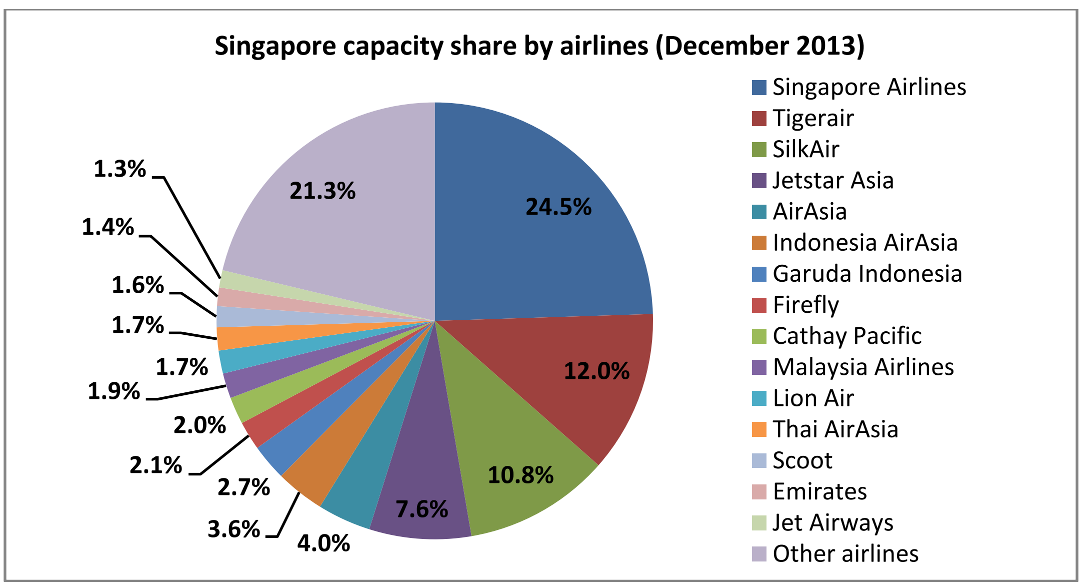
In the case of Thai Airways-Suvarnabhumi Airport, Suvarnabhumi receives 36% of passengers from Thai Airways, denoting a high dependence of Suvarnabhumi on Thai Airways; while Thai Airways locate Suvarnabhumi as its main hub, denoting a high dependence of Thai Airways on Suvarnabhumi. This then gives them motivation to cooperate in the form of facilities investment. This is a common pattern between flag airline and capital city's airport in Southeast Asia, where flag airline set its capital city as the main hub thus leads to mutual dependency.

It is notable that this observable fact is corresponding with the result presented in Chapter three, where we found that airport is more likely to cooperate with the dominant airline. It is confirmed here that in practice, airport is indeed cooperating with its largest airline, either in form of bilateral incentive scheme, facility investment, or other forms of cooperation.

5.3.3 TRANSIT INCENTIVE SCHEME

Transit incentive is a variation of airport incentive scheme. It is commonly defined as incentive that is given by airport to airlines based on the growth in transit passengers. This is a common practice in airports that seek to strengthen its position as a hub in one area or region (as has been practiced by Vienna Airport, explained in Section 2.3).

We observed a unique transit incentive scheme at Changi Airport in Singapore, where the incentive is given directly from the airport to the transit passengers. Under the name of Changi Transit Program, transit passengers of Singapore Airlines and SilkAir receive a shopping voucher that can be used in concession areas at Changi. Passengers of Singapore Airlines can redeem S$40 (US$32) Changi Dollar Voucher when transit through Changi, while passengers of Silk Aircan redeem S$20 (US$16) voucher. The program lasts from October 2012 - March 2014.



Source: CAPA

Figure 5.10 Singapore Airlines as the largest airline at Changi Airport

The transit incentive program only applies to passengers of Singapore Airlines and SilkAir, where Changi Airport is the hub airport for those airlines. Singapore Airlines is by far the dominant airline at Changi with 34% capacity share. Meanwhile, SilkAir, a whole subsidiary of Singapore Airlines, has 7% capacity share (Figure 5.10). Singapore Airlines is the flag carrier of Singapore owned in majority by Temasek Holdings, a government-owned investment company.

Under such program, airport and its dominant airline cooperate together in enhancing the passenger experience, aiming to increase growth of passengers especially in the long-haul transit segment. The transit incentive may motivate the passengers to use indirect flights offered by Singapore Airlines and SilkAir, due to the opportunity to shop free at Changi. It may also motivate passenger to spend time at concession area at Changi that possibly leads to higher commercial revenue for airport. This in essence is similar with commercial revenue sharing agreement (as has been discussed in Section 3.2), though the incentive is given to the passengers directly. It is necessary to observe the financial impacts of the incentive scheme, however information related to any financial data is confidential. Airport does not publish detailed information about the influence of incentive scheme on their revenues. It is well-known fact that airports try to measure the impact of their incentive scheme, but the results are confidential.

5.3.4 AIRLINE-AIRPORT COOPERATION AND AIRLINE DOMINANCY

In summary, three forms of cooperation—airport incentive for route and traffic development, airline investment on airport facilities, and transit incentive—are discussed. We use multiple case study approach; interaction process is considered as longitudinal issue where case study method is the most appropriate approach (Yin, 1994). While motivation and objective of cooperation vary from one form to another, we observe that cooperation between airline and airport happens when they have high mutual dependence, where dependency is resulted from the dominance of airport on airline as well as from the dominance of airline on airport.

Liberalization in Southeast Asia region, albeit limited both in concept and in implementation, may provide motivation for airline and airport to cooperate. Based on the observation, it is found that cooperation only happens between local airlines with local airports – cooperation occurs within one country. The term ‘local’ here means ownership of airline/airport is embedded domestic. There is no cross-country cooperation; airline of one country currently does not cooperate with airport in another country.

Air transport liberalization in ASEAN, under ASEAN Open Skies policy, still enforces limitation on freedom of flight and on airline ownership and control. Thus, dominancy and dependency most likely occurs between local airline and local airport. It is unlikely for foreign airline to be the dominant airline. As shown in Table 5.9, the dominant airline in each airport is the local airline, except for Phnom Penh (Cambodia), Siam Reap (Cambodia), and Nay Pyi Taw (Myanmar) airports. The dominant airline in the Phnom Penh and Nay Pyi Taw airports is Bangkok Airways, an airline from Thailand. Meanwhile, the dominant airline in Siam Reap airport is Vietnam Airlines.

Table 5.9 also gives information on the market concentration in each airport. Market concentration is quantified by using Herfindahl–Hirschman Index (HHI) based on airlines’ weekly flight frequency share. The HHI takes into account the relative size distribution of the firms in a market. It approaches zero when a market is occupied by a large number of firms of relatively equal size and reaches one when a market is controlled by a single firm.

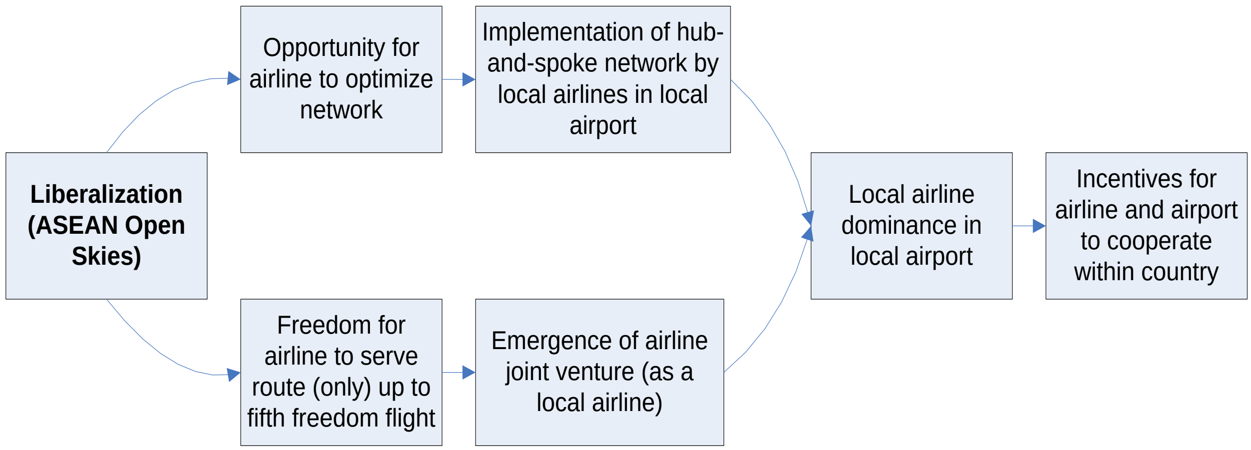


Figure 5.11 Liberalization and airline-airport cooperation in ASEAN

Figure 5.11 responds to the premise presented in Figure 4.9. Liberalization in the aegis of ASEAN Open Skies may provide motivation for airline-airport cooperation *within country*. This is different from the case of liberalization and airline-airport cooperation in European countries (Figure 2.2) where cooperation can happen between any airline and any airport regardless the country origin. After the enforcement of EU Open Skies by 1997, European airlines could fly without restrictions between any two points within European Aviation Area. Airlines could perform seventh freedom of flight and set base in any airport, therefore there is a possibility of foreign airline to be a dominant airline at airport. Ryanair (origin from Ireland), for example, can set base and become the dominant airline at Stansted Airport in London, and this leads to close cooperation between them in form of bilateral incentive scheme (Ryanair website, 2013). Liberalization in ASEAN also does not yet lead to privatization between airports. As discussed in Section 5.2, majority of airports in Southeast Asia are government-owned.

Table 5.9 Dominant airline in selected airports

Country	Airport	Dominant airline	Market share	HHI
Thailand	Suvarnabhumi	Thai Airways	33.5%	0.144
	Chiang Rai	Nok Air	40.2%	0.325
	Chiang Mai	Thai AirAsia	24.6%	0.166
	Hat Yai	Thai AirAsia	46.2%	0.352
	Phuket	Thai AirAsia	20.3%	0.103
	Udon Thani	Nok Air	43.2%	0.264
	Krabi	Thai AirAsia	34.1%	0.263
	Don Mueang	Thai AirAsia	53.0%	0.433
Malaysia	Kuala Lumpur	Malaysia Airlines	34.8%	0.253
	Kinabalu	Malaysia Airlines	49.1%	0.384
	Kuching	Malaysia Airlines	50.7%	0.451
	Langkawi	AirAsia	47.7%	0.315
	Penang	AirAsia	24.6%	0.130
	Senai	AirAsia	47.8%	0.305
	Kota Bharu	Firefly	35.4%	0.247
Indonesia	Jakarta	Garuda	31.4%	0.244
	Surabaya	Lion Air	47.5%	0.287
	Denpasar	Garuda	27.7%	0.179
	Solo	Lion Air, Garuda	31.0%	0.237
	Yogyakarta	Lion Air	49.6%	0.325
	Semarang	Lion Air	44.2%	0.295
	Makassar	Lion Air	55.0%	0.372
	Lombok	Lion Air	61.5%	0.444
	Manado	Lion Air	58.2%	0.423
	Balikpapan	Lion Air	48.2%	0.307
	Banjarmasin	Lion Air	58.2%	0.386
	Medan	Sriwijaya Air	42.9%	0.357
	Pontianak	Garuda	27.9%	0.212
	Padang	Lion Air	38.3%	0.260
	Pekanbaru	Lion Air	43.1%	0.294
	Palembang	Lion Air	39.7%	0.316
	Bandung	Indonesia AirAsia	35.3%	0.308
	Aceh	Lion Air, Garuda	38.4%	0.313
	Batam	Lion Air	49.1%	0.333
Cambodia	*Phnom Penh*	*Bangkok Airways*	14.6%	0.069
	Siam Reap	*Vietnam Airlines*	25.4%	0.118
Singapore	Changi	Singapore Airlines	24.5%	0.099
Brunei	Bandar Seri Begawan	Royal Brunei	75.2%	0.584

Table 5.9 (continue) Dominant airline in selected airports

Country	Airport	Dominant airline	Market share	HHI
Laos	Luang Prabang	Lao Airlines	56.9%	0.373
	Vientiane	Lao Airlines	61.2%	0.401
Vietnam	Hanoi	Vietnam Airlines	59.5%	0.379
	Ho Chi Minh	Vietnam Airlines	50.6%	0.289
	Da Nang	Vietnam Airlines	63.4%	0.438
	Hai Phong Cat Bi	Vietnam Airlines	51.3%	0.384
	Nha Trang Cam Ranh	Vietnam Airlines	74.4%	0.594
Myanmar	Yangon	Air KBZ	15.6%	0.067
	Mandalay	Air KBZ	25.9%	0.194
	Nay Pyi Taw	*Bangkok Airways*	58.3%	0.513
Philippines	Manila	Cebu Pacific	34.4%	0.190
	Mactan Cebu	Cebu Pacific	50.3%	0.299
	Clark	Tigerair Philippines	42.5%	0.259
	Iloilo	Cebu Pacific	59.1%	0.460
	Zamboanga	Cebu Pacific	56.0%	0.507
	Puerto Princesa	Cebu Pacific	35.2%	0.276
	Laoag	PAL Express	58.8%	0.516
	Kalibo	Zest Air	27.8%	0.208
	Davao	Cebu Pacific	50.6%	0.326

Source: CAPA data; market share is calculated based on weekly flight frequency

5.4 POLICY IMPLICATIONS

Henceforth, policy implication of airline-airport cooperation in Southeast Asia is discussed. This study argues that increasing attention needs to be paid to vertical cooperation between airline and airport. Vertical cooperation may increase benefit and production efficiency, however the purpose of the cooperation is not necessarily to achieve greater efficiency but may well be to exert greater market power that negatively affects downstream competition (Serebrisky and Presso, 2002). Policy development in ASEAN member states therefore needs to take greater account of the extent to which the market has changed due to liberalization and is continuing to do so.

5.4.1 ANTI-COMPETITIVE PRACTICES AND COOPERATION WITHIN COUNTRY

Cooperation can take many forms depending on the objective and motivation of airline and airport. The intensity of influence to market differs from one cooperation form to another. Not all cooperation results in anti-competitive practices. Incentive scheme, for example, if apply equally for any airlines is unlikely to disturb downstream airline competition (FAA, 2010).

Anti-competitive practices are such that limit, restrict, or distort either competition or market access by aim or effect, or constitute an abuse of a dominant market position. Serebrisky (2003) lists set of practices that the airport operator, if cooperate or is integrated with its dominant airline, could use to affect competition in the airline market:

1. *Diminution of quality*. The airport operator could reduce the quality of services rival airlines can offer through its allocation of check-in space, seats in gate areas, VIP lounges and office space.
2. *Discrimination in access to ground handling services*. If the airport operator controls the supply of ground handling services (baggage, passenger, and aircraft assistance).
3. *Increases in transaction costs*. The operator could increase costs for competing airlines, such as through administrative norms on access to the airport.
4. *Predatory practices*. Using cooperation mechanism, airport operator could reduce cost and/or increase marginal revenue per movement of the dominant airline so that allow it to set predatory prices in downstream market – as shown in commercial revenue sharing agreement, dominant airline under cooperation can reduce its airfares, undermining the profitability of competing airlines.
5. *Slot assignment discrimination (take-off and landing rights)*. If the right to assign slots is in the hands of the airport operator and there is congestion, the operator can reserve the most convenient slots for its dominant airline. Thus, competing airlines will get the slots that are least convenient for passengers. In this way the dominant airline is able to capture a great portion of the demand for inbound and outbound flights from the airport.

As discussed before, ASEAN Open Skies policy enforces limitation on freedoms of flight and on airline ownership and control; therefore cooperation most likely occur only between local airline and local airport within country. Major flag airlines hold a dominant position in each of their home markets. Flag airlines in Southeast Asia exert varying degrees of influence over their own governments, typically resulting in protectionist policies being exercised in their favor (Tan, 2009). Cooperation between airlines and airports in Southeast Asia has received little attention probably due to the public utility status of airports and flag airlines. We assume that the public sector owners, acting in public interest, did not exploit its market power. However, this situation is changing. Regional liberalization, under the aegis of the ASEAN Open Skies may potentially push airline and airport to become more competitive, creating a greater need for close cooperation between certain airports and airlines. Policy makers need to consider this within-country cooperation in order to ensure fair airline downstream competition in the whole region, especially because countries in ASEAN have diverse policies, geographical conditions, and infrastructure so that some are hesitant to move forward and tend to protect their market toward foreign airlines, as the case of Indonesia. Close airline-airport cooperation can be established with protective mechanism against rivalry from foreign airlines, either by aim or by effect.

The higher intensity of vertical cooperation lies in the vertical integration between airport operator and its dominant airline. It is worth noting that Indonesian Ministry of State Enterprises on February 2013 has announced a plan to integrate Indonesian flag airline Garuda Indonesia and the airport operator Angkasa Pura I and II into one holding company (Cakti and Chevny, 2013). This plan is still on-hold and likely subjected to competition law. Nonetheless, this vertical integration (merger) issue is particularly relevant with what has been discussed in this study. Vertical cooperation, especially vertical integration, under regional liberalization may need to be reviewed from the perspective of fair competition in order to achieve the aim of liberalization itself, which is to attain efficient and competitive international air services that are important to benefit consumers and promote economic growth in the region.

International experiences dealing with airport vertical cooperation and integration are available. Currently some countries like Australia have specific rules prohibiting vertical integration between airlines and airports and a maximum of five percent of the shares of an airport may be bought by an airline (Australian Productivity Commission, 2011). The European Commission also applies the competition rules on mergers and alliances, price-fixing and other arrangements to the air transport sector under EU open skies. Furthermore, a strict enforcement of state aid rules does ensure that airlines operate in a level playing field (European Commission, 2013).

5.4.2 Competition Laws in ASEAN

The purpose of this section is to review competition laws in ASEAN member states, with emphasis on the issue of vertical agreements, cooperation or merger. It should be noted that the review provided here is not an in depth review of each member states but more about the general review of the current enforcement in ASEAN.

Competition is an important aspect of ASEAN's vision of regional economic integration. The formation of a single market, including single aviation market, is premised upon the notion of competition across markets in the ASEAN countries. Competition ensures that the benefits from regional integration are equitably distributed between and amongst producers and consumers in the region as well as amongst ASEAN member states. In this regard, competition policy, defined as any governmental policy that promotes competition in markets, is an important policy in the realization of the single market in ASEAN.

1. Definition of Competition Policy and Competition Law

In AEC Blueprint (revisit Figure 4.1), competition policy is placed as a priority area under the objective of achieving a competitive economic region. Definition of competition policy stated in the ASEAN Regional Guidelines on Competition Policy (ASEAN, 2010a):

"Competition policy can be broadly defined as a governmental policy that promotes or maintains the level of competition in markets, and includes governmental measures that directly affect the behavior of enterprises and the structure of industry and markets."

The above broad definition of competition policy suggests that some of the policies that enhance the market liberalization can be considered to be competition policies in so far as they enhance the degree of competition in markets. Competition policy therefore includes but is not restricted to competition law. Competition law is one component (albeit a very important one) of competition policy. National competition law is defined in ASEAN (2010) as "legislations that support competition by prohibiting anti-competitive agreements, abuse of dominant position, anti-competitive mergers and other restrictive trade practices". The efficacy of competition laws depends on the presence of relevant enforcement agencies (i.e., competition commission).

2. Competition Law Implementation in ASEAN

National competition law is a relatively new phenomenon in ASEAN. Among the ten member states, only five have implemented comprehensive full-fledged competition law: Indonesia, Thailand, Singapore, Vietnam, and Malaysia (Table 5.10). Singapore's law was passed in late 2004 and became effective at the beginning of 2005. Vietnam's law was passed in November 2004 and became effective in July 2005. Laos Decree No. 15/PMO on Competition was issued in August 2004, but the Decree has not been implemented to date. Competition issues in the Philippines are addressed through several different laws that are enforced by the respective sector regulations. Two countries, Brunei and Myanmar, have yet to draft their competition laws.

Competition laws among the member states differ in terms of a number of dimensions that include the objectives of the law, content, and legal standard. However, they generally prohibit three main practices: (i) anti-competitive agreements; (ii) anti-competitive mergers; (iii) abuse of a dominant position or a monopoly (ASEAN, 2010).

Table 5.10 Competition laws and authorities in ASEAN

States	Implemen-tation	Year	Details	
			Competition Law	Competition Authority
Indonesia	Yes	1999	Law No. 5, 1999	Commission for the Supervision of Business Competition (KPPU)
Thailand	Yes	1999	Trade Competition Act BE 2542 (AD 1999)	Trade Competition Commission
Singapore	Yes	2005	Competition Act (Cap. 50 B)	Competition Commission of Singapore
Vietnam	Yes	2005	Competition Law No. 27/2004/QH11	Vietnam Competition Council (adjudication) and Vietnam Competition Authority (investigation)
Malaysia	Yes	2010	Competition Act 2010	Malaysia Competition Commission
Lao PDR	No	-	Decree 15/PMO on Trade Competition (enacted in 2004 but not enforced)	Trade Competition Commission
Philippines	No	-	Competition-related provisions in the 1987 constitution	Office for Competition
Brunei	No	-	National competition law expected by 2015	
Cambodia	No	-	Draft law under consideration of Council of Ministers	
Myanmar	No	-	National competition law expected by 2015	

Source:Drew & Napier LLC (2013) and competition law of each member state

Anti-competitive agreements are agreements or other arrangements between market operators that negatively affect competition in a specific market. Anti-competitive agreements may be horizontal, i.e., between market operators operating at the same level in the market chain, or vertical, i.e., between market operators operating at different level of the market chain.

Anti-competitive mergers are mergers, acquisitions, or joint-ventures that lead to a restriction of competition. For many jurisdictions the merger test is whether there is a substantial lessening of competition. This includes both horizontal and vertical merger.

Abuse of dominant position covers practices where a business operator with substantial market power restricts competition in a market. The notion of dominant position or substantial market power may vary according to national legislation, but generally it refers to a situation where the business operator has enough economic strength to act in the market what its competitors (actual or potential) do. In order to determine dominance, competition law may refer to market shares and/or series of other market structure indicators, such as the extent of vertical integration, technological advantages, and financial resource. Seeking or reaching dominant position is usually not prohibited, only abuse of a dominant position. Abuse behaviors can either be in the form of excluding competitors through predatory pricing or exclusive dealing contracts with the only supplier or materials needed for production.

Prohibited practices on member states' competition laws are reviewed and listed in Table 5.11. The list does not aim to be inclusive, but means to highlight the issue of vertical agreements and integration. Several points are worth noting:

- Under Singapore law, not all vertical agreements are considered anti-competitive. Only horizontal agreements are prohibited under Section 34. Vertical agreements are excluded from the Section 34 prohibition (ASEAN, 2013).
- Under Law No. 5, 1999, vertical integration in Indonesia is prohibited. The Law presumes all vertical integration as anti-competitive regardless the impact of the vertical integration (Aswicahyono and Kartika, 2010). Under Article 47, KPPU may impose sanctions including orders to stop any vertical integration.
- Under competition Trade Competition Act of Thailand, Section 27 prohibits a business operator from conspiring, colluding or collaborating with another business operator (horizontally or vertically) in order to create monopolistic power, or reduce competition.
- Competition Act 2010 of Malaysia does not impose any regulation regarding merger.

Table 5.11 Prohibited practices listed on competition laws

Member states	Anti-competitive agreement	Abuse of dominant position	Merger control
Indonesia	Price fixing (Article 5), agreements leading to vertical integration (Article 14), price discrimination (Article 6), collusive tendering (Article 22)	Market control or market barrier (Article 19), predatory pricing (Article 20)	Merger leading to anti-competitive monopoly (Article 28 and 29), vertical integration (Article 47)
Singapore	Price fixing, bid rigging and market sharing (Section 34)	Exclusive dealing, predatory pricing, discount scheme (Section 47)	Merger leads to a substantial lessening of competition (Section 54)
Malaysia	Price and quantity fixing, bid rigging and market sharing (Chapter 1)	Market control, any predatory behavior, investment limitation (Chapter 2)	-
Thailand	Price and quantity fixing, market control, agreement to have market domination (Section 27)	Market barrier (Section 29), Market domination (Section 30)	Merge businesses result in monopoly or unfair competition (Section 26)
Vietnam	Price and quantity fixing, bid rigging and market sharing (Article 8)	Predatory pricing, market barrier (Article 13)	Merger leads to economic concentration (Article 18)

Source: based on Law No. 5/1999 (Indonesia), Competition Commission website (Singapore), Competition Act 2010 (Malaysia), Trade Competition Act BE 2542 (Thailand), Competition Law No. 27/2004/QH11 (Vietnam), compiled by author.

Although ASEAN does not have a single competition commission as the case of EU, there is an establishment of ASEAN Experts Group on Competition (AEGC). The AEGC was established in 2007 with the mandate of overseeing competition related matters in ASEAN. It currently deals on capacity building activities to encourage development of national competition policy (Lee and Fukunaga, 2013). AEGC may act as a single competition commission in the future, and this is considered necessary under single market, since prohibited practices may need to be dealt in the basis of fairness all members in the region, and not only on national basis. Lee and Fukunaga (2013) point out that none of the member states' competition laws has regional integration as an objective, given that the AEC was only declared in 2003. This point may worth mentioning because in jurisdictions where regional integration is an important objective, such as the EU, competition law may focus on both competition as well as single market jurisdiction.

3. Competition Law related to Air Transport

The competition laws generally apply to all sectors including air transport sector. As a case example, in Indonesia, airline operators discussed airline tariff and set among themselves through their membership in INACA (Indonesia National Air Carriers Association). KPPU considered this is as a cartel, and therefore recommended the government to forbid this tariff setting arrangement. As a result, in 2002, Ministry of Transportation issued a regulation that this tariff setting arrangement no longer put in place and the tariff went down significantly afterwards (Aswicahyono and Kartika, 2010).

Table 5.12 Aviation policy and authority in ASEAN member states

States	Authorities	Aviation Policy
Brunei	Department of Civil Aviation	Civil Aviation Order, 2006
Cambodia	State Secretariat of Civil Aviation	Civil Aviation Law of Cambodia, 2008
Indonesia	Directorate General of Civil Aviation	Law No. 1, 2009
Lao PDR	Department of Civil Aviation	Law of Civil Aviation, 2005
Malaysia	Department of Civil Aviation	Civil Aviation Regulations 1996[a]
Myanmar	Department of Civil Aviation	Myanmar Aircraft Act, 1934[b]
Philippines	Civil Aeronautics Board	Executive Order No. 29, 2011
Singapore	Civil Aviation Authority	Air Navigation Act, 1975[c]
Thailand	Department of Civil Aviation	Air Navigation Act No. 11 BE 2551, 2008
Vietnam	Civil Aviation Administration	Law of Civil Aviation, 2006

[a]Last amendment in 2004; [b]Last amendment in March, 2010; [c]Last amendment in 2009

Source: collected by author

In addition to the competition law and competition commission, air transport is also regulated within the purview of a ministerial authority (Table 5.12). The authorities generally have the functions: (1) to exercise licensing and regulatory functions in respect of the provision of air services; (2) to provide air navigation services within the country; (3) to regulate safety and security in civil aviation and to exercise safety regulatory oversight over operations in the country and the operation of country's aircraft outside the country. Some of the authorities, such as Civil Aviation Authority in Singapore and Vietnam also act as the competition and fair market supervisory body over the operation and provision of airport and airline services.

In summary, competition laws in ASEAN member states (at least in Indonesia, Singapore, Malaysia, Thailand, and Vietnam) indeed cover the issue of vertical agreements or merger (revisit Table 5.11) in all business sectors including in air transport. However, the issue is covered on national basis and not on single region basis. The procedure, enforcement and assessment on the level of anti-competitive may differ from one member state to another. In addition to competition law, competitive behavior among airlines between member states is governed in their air service agreements.

5.5 CONCLUSIONS AND FINDINGS

This chapter answered the third objective of this study: to review practices of airline-airport cooperation in Southeast Asia and the policy implications. Characteristics of airports in Southeast Asia are first reviewed; characteristic may shape the attitude of airport toward airlines, which in turn influence the relationship between the airport and the airlines. It is found that majority of airports in Southeast Asia are owned and operated by single company or government authority. There is small degree of competition among airports due to far geographical location and single ownership and management of the airports. Airports in Southeast Asia focus more on aeronautical rather than commercial activities, and have high traffic from low-cost carriers.

Practices of airline-airport cooperation in Southeast Asia are then reviewed by using multiple case studies approach. Information on airline-airport cooperation is gathered from primary and a variety of secondary sources such as airport websites, newspaper articles, and reports. Interviews were conducted with Indonesian airport operator and airline counterparts.

Three forms of cooperation are found: *airport financial incentive scheme on route and traffic development*, *airline investment on airport facilities*, and *transit incentive scheme*. The practices discovered here can only serve as a lower bound of the actual prevalence of airline-airport cooperation agreements, as the presence of an agreement is often not disclosed officially.

- Based on survey, 35 out of 51 airports are found to offer incentive to the airlines. Incentives are offered based on volume growth, additional route and/or flight frequency. By using standard logistic regression, factors affecting the presence of incentive scheme at airports are analyzed. It is found that *economic activity in airport's catchment area* and *hub status* significantly affects the presence of incentive scheme. Airport management is more likely to offer incentive for route and traffic development if there is high economic activity in the airport's catchment area. Moreover, there is higher probability of the presence of incentives at an airport if the airport has hub status. Ownership structure, intensity of airport competition, and potential network development from low-cost carriers is found to be insignificant to affect the presence of incentive scheme at airports. Furthermore, some airports cooperate more closely with airlines through bilateral incentive scheme where the incentive is customized and negotiated per airline, namely Changi Singapore Airport and Batam Airport. They offer incentive scheme to their airlines, especially to airline that has large capacity share in each respective airport.
- Two cases of airline investment on airport facilities in Southeast Asia are found: (1) Lion Group invested on maintenance facilities at Batam Airport, (2) Thai Airways invested on several facilities at Suvarnabhumi Bangkok Airport. Similar pattern is observed in the case studies of Lion Air-Batam Airport and Thai Airways-Suvarnabhumi Airport: airline and airport has high mutual dependency based on their dominancy on each other.
- Transit incentive scheme is observed at Changi Airport in Singapore, where the incentive is given directly from the airport to the transit passengers. This scheme is probably unique in the world since transit incentive scheme is generally given by airport to airline. This transit

incentive program only applies to passengers of Singapore Airlines and SilkAir, where Changi Airport is the hub airport for those airlines.

While motivation and objective of cooperation vary from one form to another, we observe that cooperation between airline and airport happens when they have high mutual dependence, where dependency is resulted from the dominance of airport on airline as well as from the dominance of airline on airport. This observable fact is corresponding with the result presented in Chapter three, where it is found that airport is more likely to cooperate with the dominant or substantial airline. It is confirmed that in practice, airport is indeed cooperating with its dominant airline, either in form of bilateral incentive scheme for route and traffic development, facility investment, or transit incentive program. Cooperation practices are more apparent in the developed countries such as Malaysia, Thailand and Singapore rather than in the developing countries in ASEAN. Airline and airport management in developed countries are considered more aware of the potential benefit brought by airline-airport cooperation.

Liberalization in Southeast Asia region, albeit limited both in concept and in implementation, may provide motivation for airline and airport to cooperate. Airport development strategy, including incentive program, is likely being influenced by regional liberalization ASEAN Open Skies. Based on the observation, it is found that cooperation only happens between local airlines with local airports – *cooperation occurs within country*. There is no cross-country cooperation in Southeast Asia region; airline of one country does not cooperate with airport in another country.

This study argues this within-country cooperation may have potential anti-competitive concerns if it is reviewed from the perspective of single unified air transport market of ASEAN. Policy makers need to consider this within-country cooperation scenario in order to ensure fair airline downstream competition in the whole region, especially because countries in ASEAN have diverse policies, geographical conditions, economies, and infrastructure. Close airline-airport cooperation can be established with protective mechanism against rivalry from foreign airlines, either by aim or by effect. Examples of anti-competitive practices that the airport operator, if cooperate or is integrated with its dominant airline, could use to affect competition in the airline market are: diminution of quality, discrimination in access to ground handling services, increases in transaction costs, predatory practices, and slot assignment discrimination (Serebrisky, 2003). The intensity of influence to market, however, differs from one form of cooperation to another. Not all cooperation forms result in anti-competitive practices.

Finally, competition laws in ASEAN are reviewed. Among the ten member states, only five have implemented comprehensive full-fledged competition law: Indonesia, Thailand, Singapore, Vietnam, and Malaysia. The existing competition laws indeed cover the issue of vertical agreements or merger in all business sectors including in air transport. However, the issue is covered on national basis and not on single region basis. The procedure, enforcement and assessment on the level of anti-competitive may differ from one member state to another. Furthermore, ASEAN currently does not have a single competition commission that arranges competition rules. A single competition commission is considered necessary under single market, since prohibited practices may need to be dealt in the basis of fairness of all members in the region, and not only on national basis.

Chapter 6
Summary and Conclusions:
Airline-Airport Cooperation in Perspective

6.1 SUMMARY AND CONCLUSIONS

This study began with the aim of better understanding the effects of airline-airport cooperation on competition level and social welfare, and the current practices and their policy implications of airline-airport cooperation in Southeast Asia.

Chapter one provided a brief overview on cooperation between airline and airport. Past studies has argued that airline-airport cooperation is in need of further examination because of its double-edged sword effects on competitive operation levels and for adherence to regulatory requirements in the industry. This study then argued that the examination needs to be linked with liberalization process that has spread to developing countries such as Southeast Asia. Airline-airport cooperation under regional liberalization need to be reviewed from the perspective of fair competition in order to achieve the aim of liberalization itself, that is to attain competitive international air services that benefit consumers and economic growth in the region. Therefore, three specific objectives were set for the investigation and were tackled in Chapter three until five.

Chapter two provided an extended overview on cooperation between airline and airport. This chapter structured the relationship between liberalization and airline-airport cooperation, based on past experiences. Liberalization brought several common changes that eventually trigger airline and airport to cooperate together, namely: (i) the move from point-to-point to hub-and-spoke network that leads to creation of hub premium; (ii) the rise of low-cost carriers, (iii) privatization of airports that triggers airports to be more cost-conscious and competitive among each other. Further, this chapter explained various forms of airline-airport cooperation. Eight forms of cooperation entailing financial ties between airline and airport are identified: airline ownership of airport facilities, signatory airlines of airports, long-term facility contract, airport issuance of revenue bonds to airlines, airport incentives for route and traffic development, discount on aeronautical charges (bilateral incentive), revenue sharing, and load factor guarantee. Further, this chapter summarized the existing studies that examine the effects of airline-airport cooperation using formal mathematical model. This chapter therefore becomes the basis for comparison: (i) how the mathematical model developed in this study differs from the existing ones; (ii) how relationship between liberalization and airline-airport cooperation in Southeast Asia differs from that of other regions such as in EU.

Chapter three developed airline-airport cooperation model. The objective was to provide a model that can systematically examine the effect of airline-airport cooperation on social welfare and the level of competition. The model accommodates application involving multi airports, multi airlines, and various network settings. These features are important to make the model applicable in practical world, as well as to take into account the idea of liberalization. As explained in Chapter two, the degree of liberalization in international air services can be seen from air service agreements that determine the airlines network. Therefore, this study modeled airline-airport cooperation utilizing game theory and network model approach; so that the assessment of airline-airport cooperation can be done under various network settings, including in a liberalized network where airlines have greater freedom to expand routes because of more freedom of flights. The model was developed based on specific form of cooperation: commercial revenue sharing. Commercial revenue sharing was chosen as a focus because commercial revenue assumes greater importance for airports these days. Some other airline-airport agreements can also be broadly categorized as revenue sharing, in the sense that airports transfer some benefits to airlines via price discount or favorable usage terms. Based on the model application on a simplified network, several findings can be summarized as follows: (i) commercial revenue sharing allows the demand complementarities between aviation and commercial services that potentially leads to higher airline-airport profits; (ii) commercial revenue sharing benefits passengers as it triggers reduction of airfares in the downstream market; (iii) commercial revenue sharing favors airline dominance in airports; an airport is likely to cooperate with its dominant airline; (iv) commercial revenue sharing between dominant airline and airport potentially disturbs airline competition as it reduce the profits of outsider airlines, especially when the airlines compete in the same network. The results and findings argue that government or regulatory monitoring is needed when there are practices of cooperation between the airport and its dominant airline. Utilizing this network approach, government or regulator may assess case per case whether revenue sharing cooperation between airlines and airports is advantageous from social welfare point of view.

Chapter four reviewed the liberalization process in Southeast Asia. The governments of ASEAN have established an agenda to liberalize air passenger services in the region by 2015, under the name of ASEAN Single Aviation Market or more commonly referred as ASEAN Open Skies. The objective of this chapter was to investigate the implementation of ASEAN Open Skies and how it may affect the airline-airport cooperation in the region. The history and agreements of air service liberalization were reviewed and the current liberalization status was also clarified. Moreover, aviation policy in Indonesia and its stance toward liberalization is reviewed. Indonesia is the one member state whose acceptance of the ASEAN liberalization agreements is critical since it has the region's largest economy, population, and air travel market. It is found that air transport liberalization in ASEAN is limited both in concept and in implementation. Limited in concept means that open skies policy in ASEAN still puts several restrictions especially on market access (freedom of flight) and airline ownership. Open skies policy in ASEAN is thus more restrictive than open skies policy in other regions such as in European Union. The term 'open' is a relative statement – the air travel market is Southeast Asia more liberalized and open than previously but it is only accentuated on the international airports. The domestic market remains regulated. Limited in implementation means that all member states have not yet agreed to ratify the necessary agreements. Indonesia was seen as the most resistant member states – the Indonesian government is more likely to accept staged rather than rapid liberalization in order to give airline and airport industries more time to adjust to the new level of competition. There are several opportunities identified for Indonesia to pave its way toward open skies, namely improving airport infrastructure, opening secondary cities as alternative hubs, and pursuing more external relations between ASEAN and third countries. Furthermore, limitation on airline ownership has driven the Southeast Asian airlines to establish joint venture or subsidiary in other country. By doing so, the airlines can extend their networks and set base outside the origin country. This has been applied by Southeast Asian low-cost carriers such as AirAsia, Lion Air, Jetstar, and Tigerair. However, liberalization in Southeast Asia, albeit limited in concept and implementation, has triggered significant traffic growth and may also trigger cooperation between airline and airport.

Chapter five addressed the call for investigation on real practices of airline-airport cooperation in Southeast Asia mentioned in Chapter four. This chapter aimed to analyze the current practices of airline-airport cooperation in Southeast Asia and the policy implications. Characteristics of airports in Southeast Asia were reviewed; characteristic may shape the attitude of airport toward airlines, which in turn influence the relationship between the airport and the airlines. It is found that majority of airports in Southeast Asia are owned and operated by single company or government authority. There is relatively low degree of competition among airports due to far geographical location and single ownership and management of the airports. Airports in Southeast Asia still focus more on aeronautical activities, and have high traffic from low-cost carriers. Practices of airline-airport cooperation in Southeast Asia are then reviewed by using multiple case studies approach. Information on airline-airport cooperation is gathered from primary and a variety of secondary sources such as airport websites, newspaper articles, and reports. Interviews were conducted with Indonesian airport operator and airline counterparts. Three forms of cooperation are found: airport financial incentive scheme on route and traffic development, airline investment on airport facilities, and transit incentive scheme. The practices discovered here can only serve as a lower bound of the actual prevalence of airline-airport cooperation agreements, as the presence of an agreement is often not disclosed officially. While motivation and objective of cooperation vary from one form to another, we observe that cooperation between airline and airport happens when they have high mutual dependence, where dependency is resulted from the dominance of airport on airline as well as from the dominance of airline on airport. This observable fact is corresponding with the result presented in Chapter three, where it is found that airport is more likely to cooperate with the dominant airline. Liberalization in Southeast Asia region, albeit limited, may provide motivation for airline and airport to cooperate. Based on the observation, it is found that cooperation only happens between local airlines with local airports – cooperation occurs within country. There is no cross-country cooperation in Southeast Asia region; airline of one country does not cooperate with airport in another country. This study argues this within-country cooperation may have potential anti-competitive concerns if it is reviewed from the perspective of single unified air transport market of ASEAN. Policy makers need to consider this within-country cooperation scenario in order to ensure fair airline downstream competition in the whole region, especially because countries in ASEAN have diverse policies, geographical conditions, economies, and infrastructure. Close airline-airport cooperation can be established with protective mechanism against rivalry from foreign airlines, either by aim or by effect. Finally, competition laws in ASEAN were reviewed. Among the ten member states, only five have implemented comprehensive full-fledged competition law: Indonesia, Thailand, Singapore, Vietnam, and Malaysia. The existing competition laws indeed cover the issue of vertical agreements or merger in all business sectors including in air transport. However, the issue is covered on national basis and not on single region basis. The procedure, enforcement, and assessment on the level of anti-competitive may differ from one member state to another.

Overall, the summary confirmed the two contributions argued in Chapter one. By utilizing game-theory network approach to examine the effects of airline-airport cooperation, the idea of liberalization is incorporated; assessment of airline-airport cooperation can be carried out based on the extent of network liberalization. Through this model, the cooperation parties in a given network settings can be predicted. The finding suggests that airport is more likely to cooperate with its dominant airline. This result was then confirmed by real practices in Southeast Asia mentioned in Chapter five: airport is indeed cooperating with its dominant airline, either in form of bilateral incentive scheme for route and traffic development, facility investment, or transit incentive program. This study shows that cooperation most likely occurs within country due to limited regional liberalization in Southeast Asia, and this is different from practices in other liberalized regions such as EU. Therefore, the study provided contributions on the overall researches of airline-airport cooperation – providing perspectives from the developing Southeast Asia countries.

6.2 RECOMMENDATIONS FOR AIRLINE-AIRPORT COOPERATION ASSESSMENT

As this study made to conform to the academic requirement of a doctoral program in an *international development engineering* discipline, the contributions to the practical world were important to note. Concisely translating the findings of this study to practical world and policy implications for airline-airport cooperation, the following points were found important to consider:

1. Airline-airport cooperation needs to be assessed in holistic view based on several criteria, such as profits, market concentration, and social welfare. In general manner, cooperation benefits the firms involved and benefits passengers, but creates anti-competitive concerns for the outsider airlines. Anti-competitive may occur in the sense that airport letting one airline achieve greater output and market share via cooperation. Generally, airport would cooperate with the dominant airline to maximize profit, further strengthening the dominant airline's market power.

   The effects of cooperation differ based on the form and implementation; not all cooperation is anti-competitive. Cooperation that leads to *favorable treatment* such as in slot assignment or in ground handling services, cross-subsides, cheaper aeronautical charge – that potentially limits, restricts, or distorts either competition or market access should be subjected to competition law. In the other hand, cooperation that does not create favorable treatment distorting competition is allowed, such as in incentive program that apply equally to all airlines. Therefore, the cooperation needs to be assessed case by case considering the impact, not only on profit or welfare, but also on market concentration, barrier to entry, and competition level.

2. Special attention needs to be paid to market where dominance of airline on an airport and dominance of airport on airline exist. Dominance can be one of the signs to be checked whether airline and airport are involved in cooperation. This is particularly important since airline-airport cooperation, especially those that entail financial ties, may not be disclosed publicly. Alternatively, regulator may request all airline-airport cooperation to be publicly disclosed.

3. General guidance for airline-airport cooperation, such as in offering incentive scheme for route and traffic development, is considered important in order to create a fair playing field among airlines and airports. International experience from developed countries such as European Union, Australia, and United States are available and can be used as reference or comparison for the design of the guidance. US FAA, for example, provides distinction between subsidizing air carriers (that is subjected to competition law) and waiving off fees as incentives. US FAA also requires incentives to be available to all similarly situated air carriers and does not allow an incentive to be tailored for a particular air carrier on an individual basis (FAA, 2010).

4. In the context of regional integration and liberalization such as in ASEAN, airline-airport cooperation needs to be examined in the basis of fairness of all member states. Policy makers or regulators may need to consider the effects of airline-airport cooperation beyond just the national basis. A single competition commission in the region is considered necessary. Opening up new markets through liberalization requires additional regulation to ensure that public services continue to be provided and that the consumer is not adversely affected. As for now, the existing competition laws in ASEAN do cover the issue of vertical agreements or integration in all business sectors including in air

transport; however, the issue is covered on national and not on single region basis. The procedure, enforcement and assessment on the level of anti-competitive differ from one member state to another.

5. With a support from sufficient policies, airport and airline can pursue cooperation in order to gain benefits such as profit improvement or business risk reduction. Airports in developing countries may pay special attention not only on primary aviation services but also on commercial activities that have been proven effective in improving profits of airline and airport.

It is the hope of this study to contribute to the goal of air services liberalization in ASEAN in improving benefit for customers and promoting economic growth, in the context of the implementation and policy implications of airline-airport cooperation, not only in theoretical manner but also in a real and practical world.

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APPENDIX A

Freedom of flights based on 1944 Chicago Convention

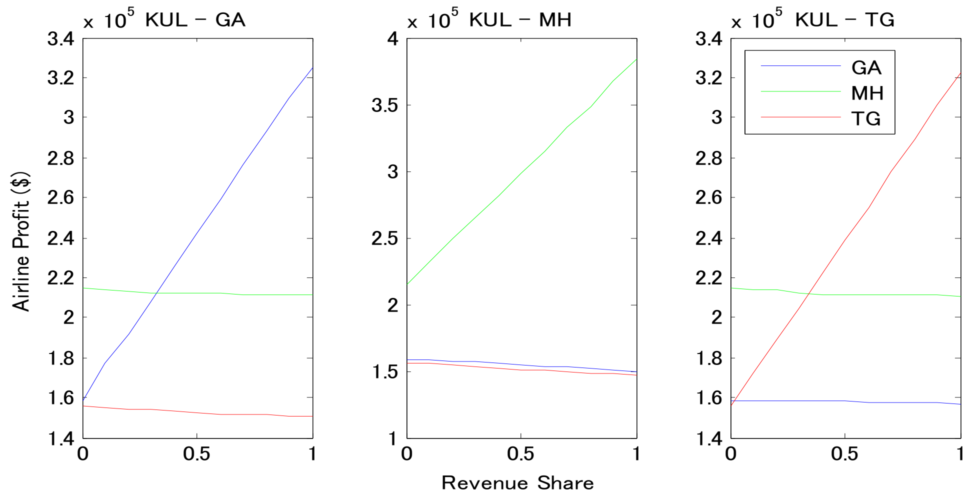
The freedoms of the air are a set of commercial aviation rights granting a country's airlines the privilege to enter and land in another country's airspace, formulated as a result of Convention on International Civil Aviation of 1944, known as the Chicago Convention.

1. First freedom: The right to fly over a foreign country, without landing
2. Second freedom: The right to refuel or carry out maintenance in a foreign country without embarking or disembarking passengers or cargo (traffic)
3. Third freedom: The right to carry traffic from airline’s own country to another country
4. Fourth freedom: The right to carry traffic from another country to airline’s own country
5. Fifth freedom: The right to carry traffic between two foreign countries and the flight has to originate or end in airline’s own country.
6. Sixth freedom: The right to carry traffic between two foreign countries via point in airline’s own country.
7. Seventh freedom: The right to carry traffic between two foreign countries without having to originate or end in airline’s own country.
8. Eight freedom: The right to carry traffic between two domestic points in foreign country while the flight originate or end in airline’s own country.
9. Ninth freedom (domestic cabotage): the right to carry traffic between two domestic points in foreign country.

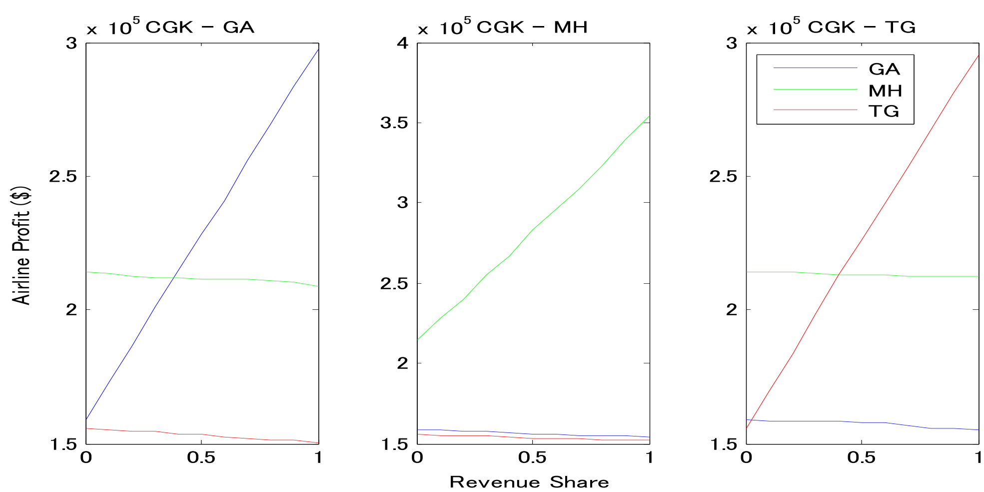
APPENDIX B

Selected Graphs from Airline-Airport Commercial Revenue Sharing Model (Chapter three)

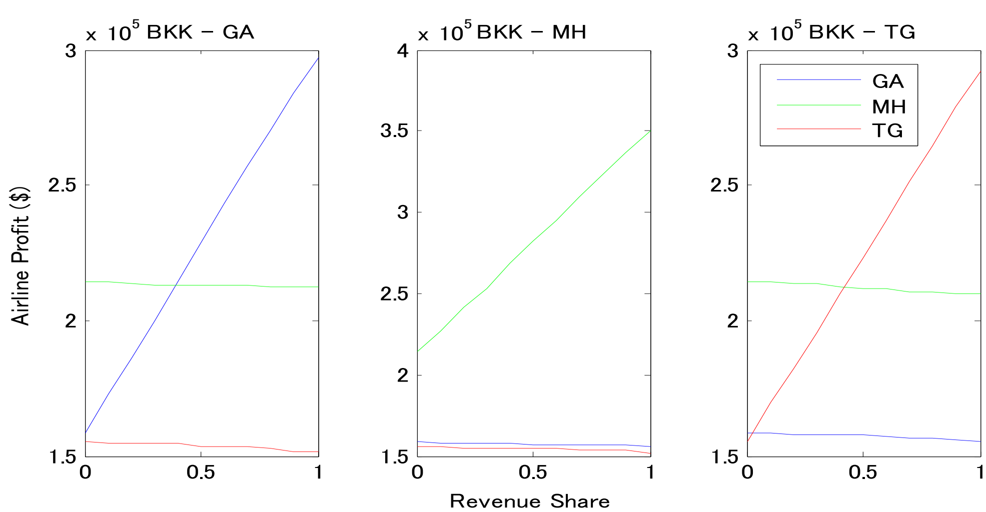
Airlines' Profit when KUL cooperates with airline GA, MH, and TG



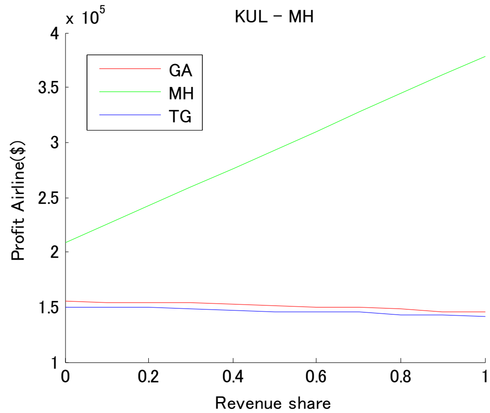
Airlines' Profit when CGK cooperates with airline GA, MH, and TG

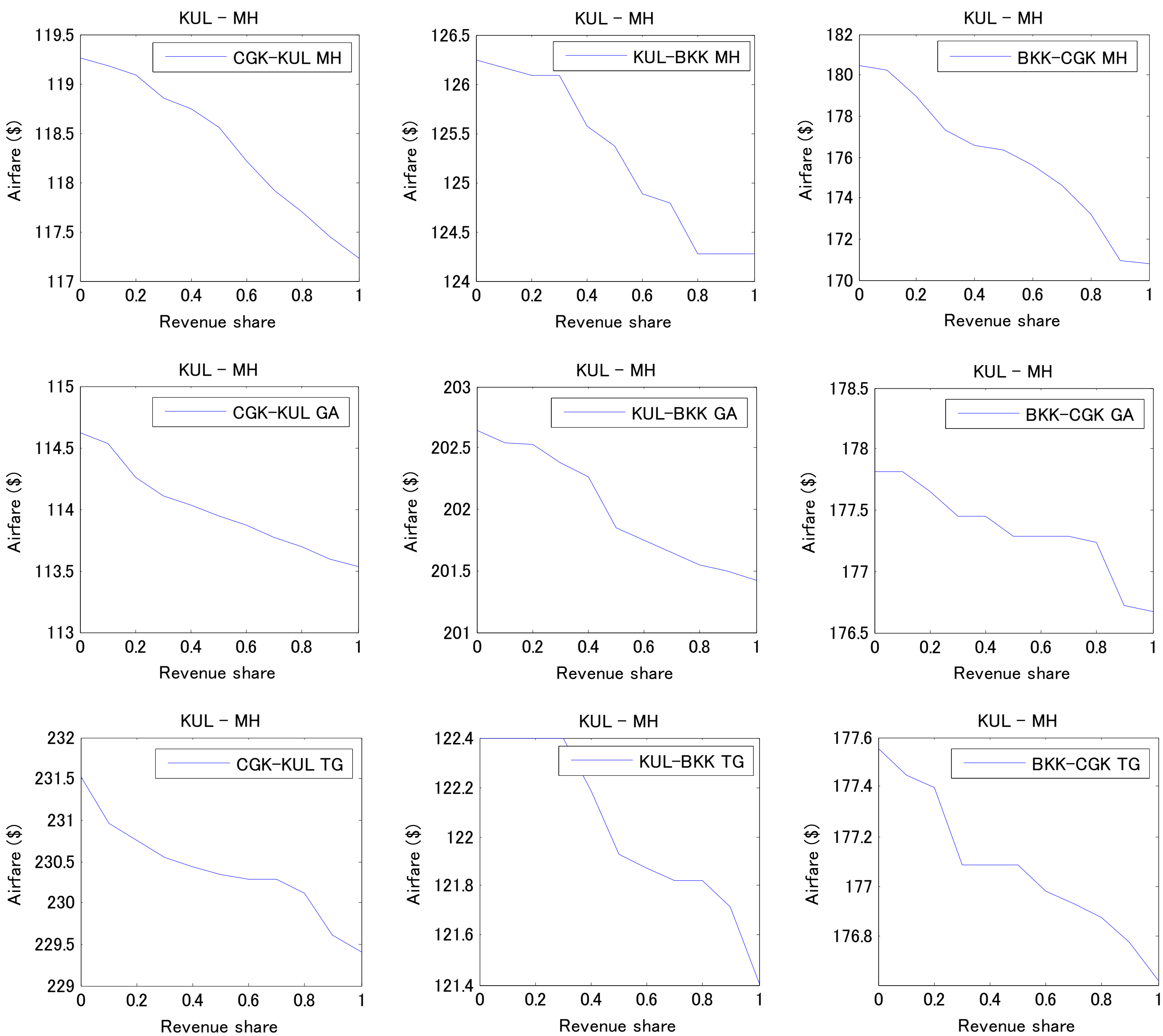


Airlines' Profit when BKK cooperates with airline GA, MH, and TG

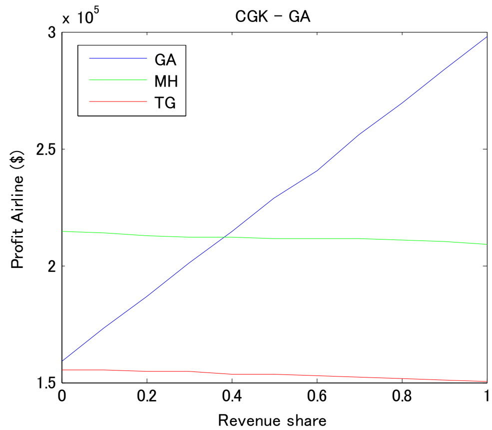


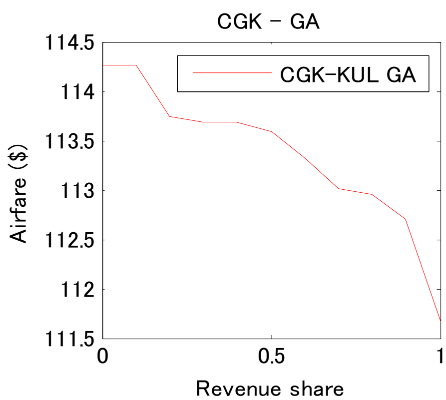
Airfare-Revenue Share Plot per flight leg: Airport KUL sharing revenue with airline MH

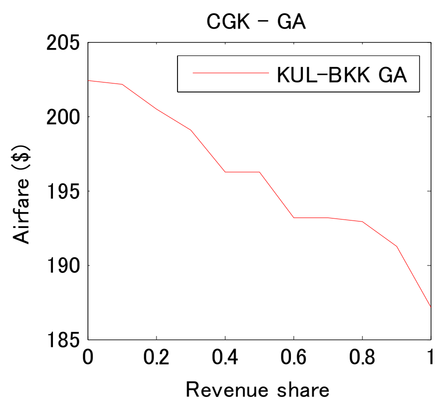


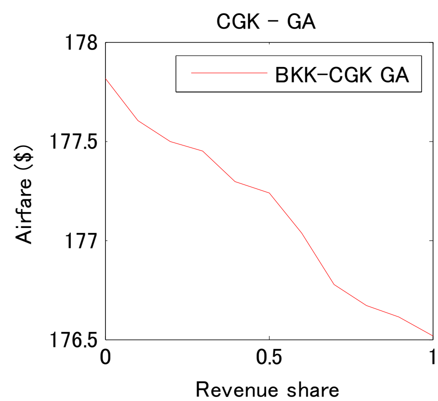


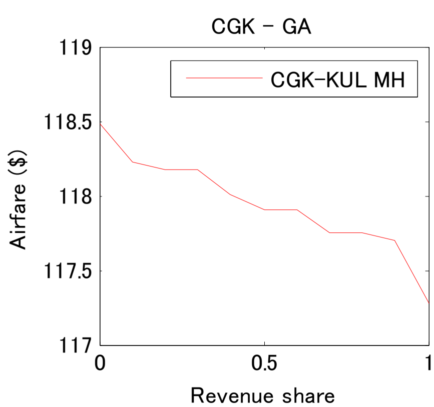
Airfare-Revenue Share Plot per flight leg: Airport CGK sharing revenue with airline GA

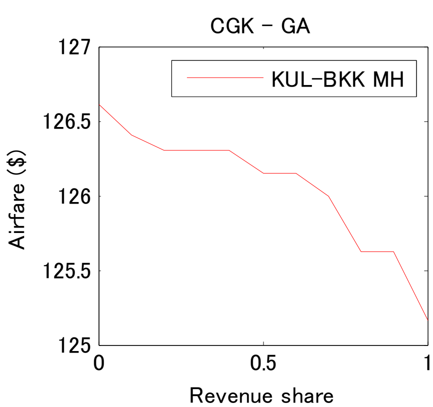

CGK - GA
x 10^5
GA
MH
TG
Profit Airline ($)
3
2.5
2
1.5
0
0.2
0.4
0.6
0.8
1
Revenue share

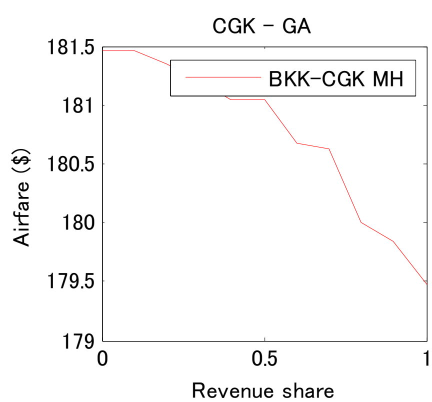

CGK - GA
CGK-KUL GA
Airfare ($)
114.5
114
113.5
113
112.5
112
111.5
0
0.5
1
Revenue share

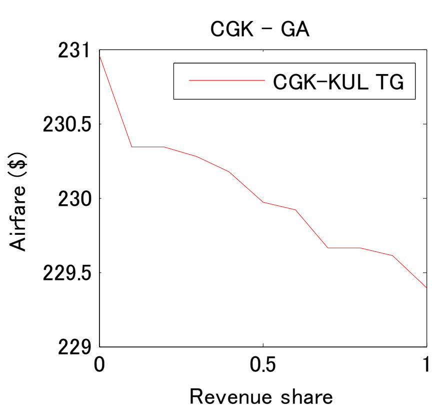

CGK - GA
KUL-BKK GA
Airfare ($)
205
200
195
190
185
0
0.2
0.4
0.6
0.8
1
Revenue share

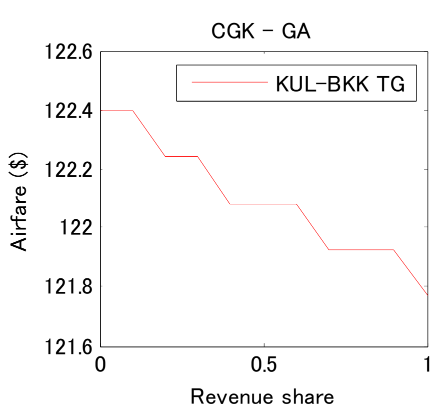

CGK - GA
BKK-CGK GA
Airfare ($)
178
177.5
177
176.5
0
0.5
1
Revenue share

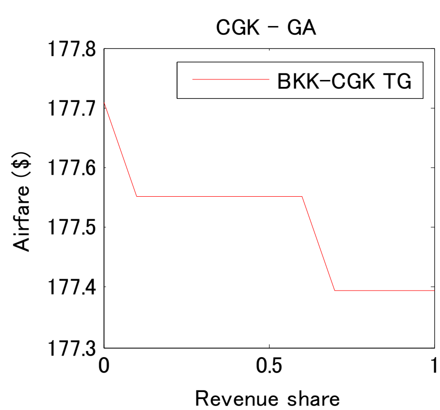

CGK - GA
CGK-KUL MH
Airfare ($)
119
118.5
118
117.5
117
0
0.5
1
Revenue share


CGK - GA
KUL-BKK MH
Airfare ($)
127
126.5
126
125.5
125
0
0.5
1
Revenue share

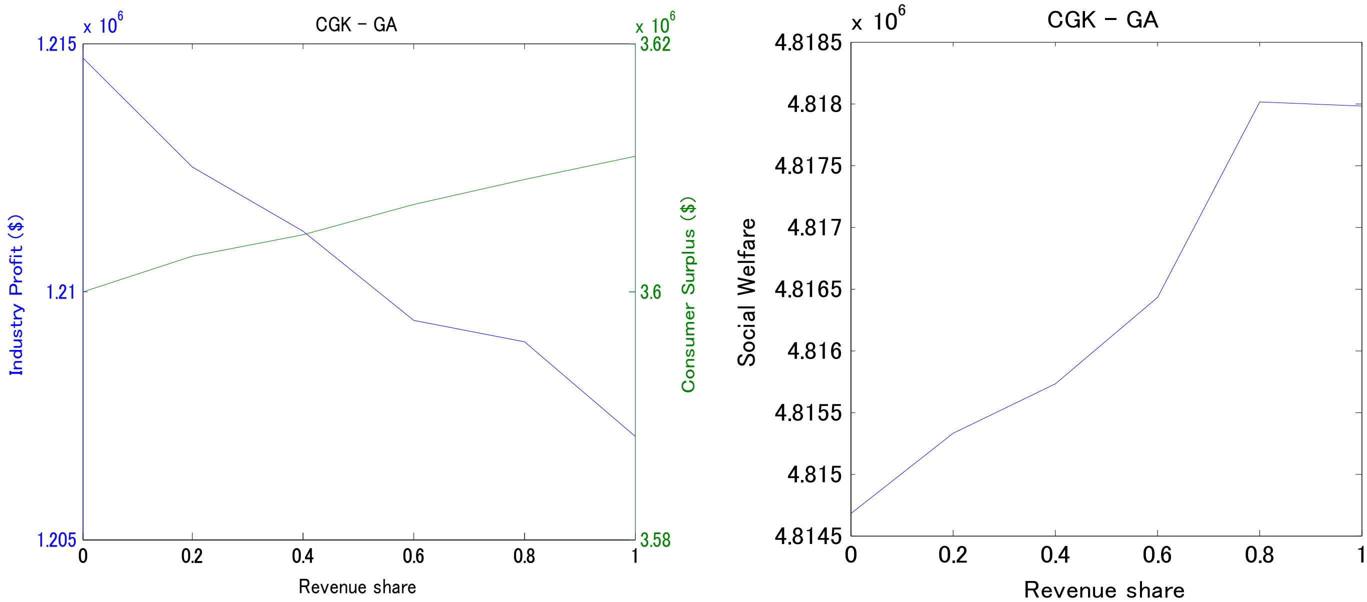

CGK - GA
BKK-CGK MH
Airfare ($)
181.5
181
180.5
180
179.5
179
0
0.5
1
Revenue share


CGK - GA
CGK-KUL TG
Airfare ($)
231
230.5
230
229.5
229
0
0.5
1
Revenue share

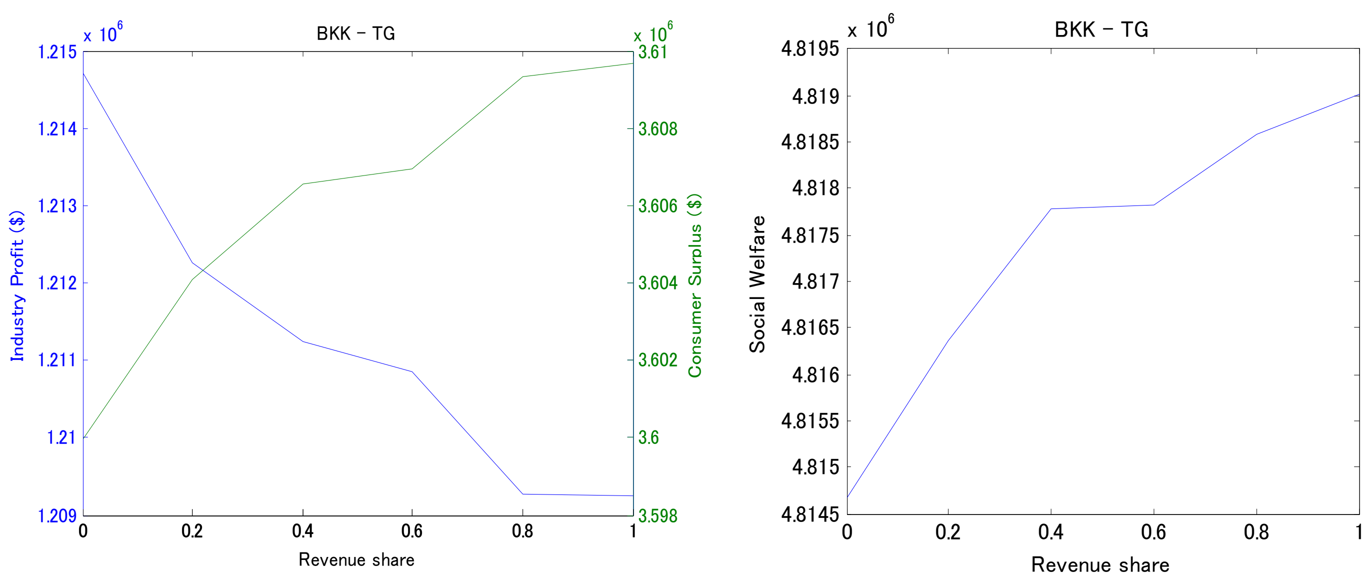

CGK - GA
KUL-BKK TG
Airfare ($)
122.6
122.4
122.2
122
121.8
121.6
0
0.5
1
Revenue share


CGK - GA
BKK-CGK TG
Airfare ($)
177.8
177.7
177.6
177.5
177.4
177.3
0
0.5
1
Revenue share

Consumer surplus, industry profit, and social welfare in case of CGK sharing revenue with GA



Consumer surplus, industry profit, and social welfare in case of BKK sharing revenue with TG

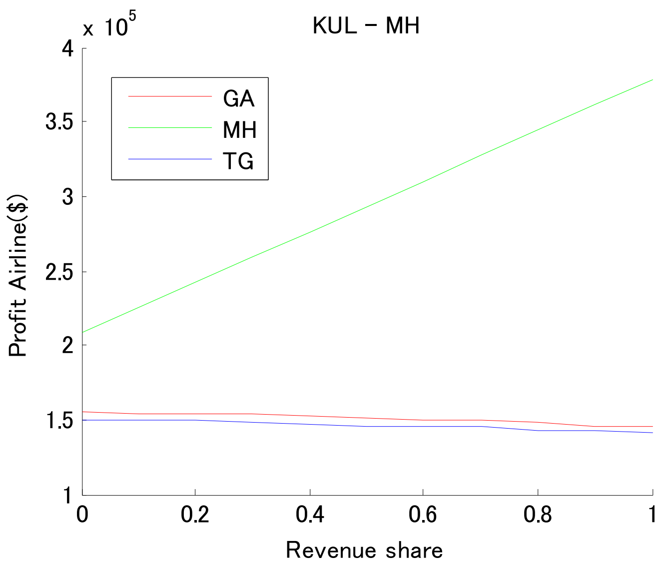


Results with Different Initial Solution

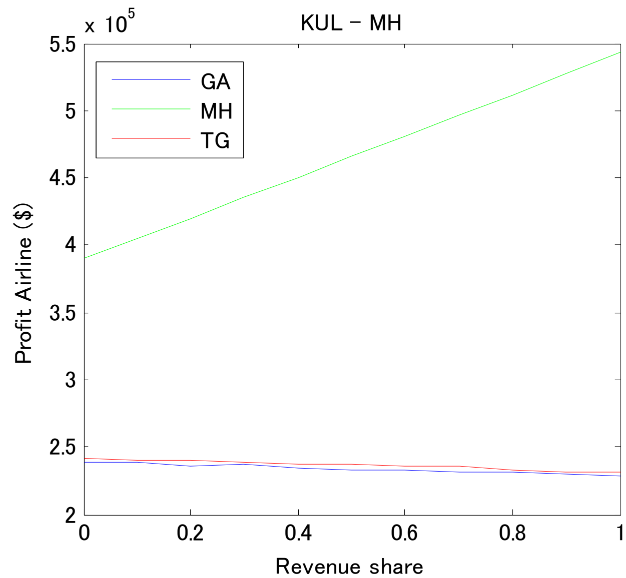
(a) **Airfare based on market data (presented in Chapter three)**

(b) **Double airfare**

Profit Airlines when KUL sharing revenue with MH

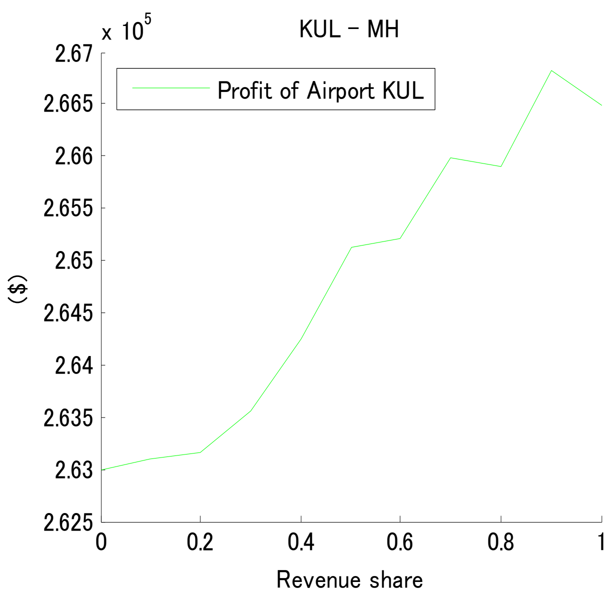


(a)

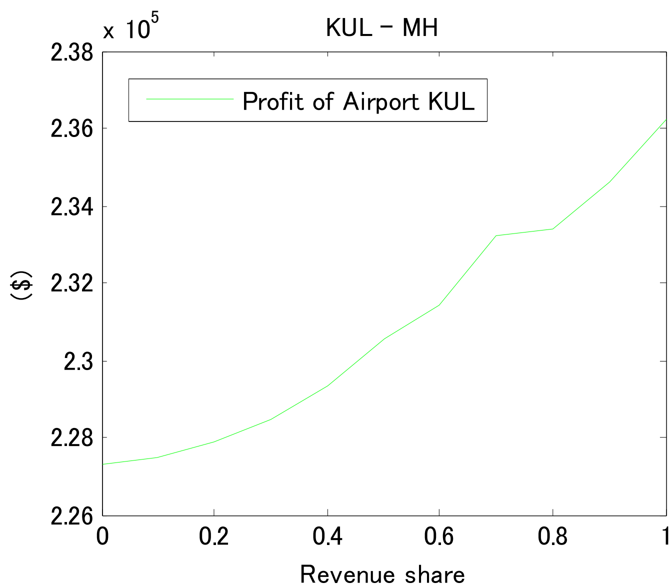


(b)

Profit Airport KUL when sharing revenue with MH

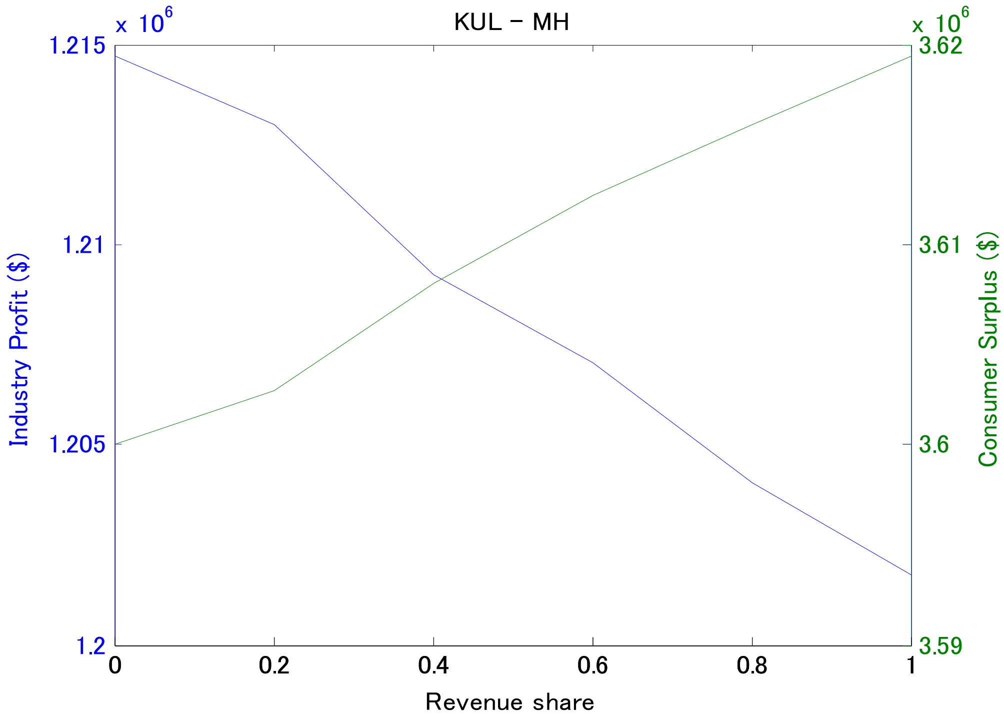


(a)

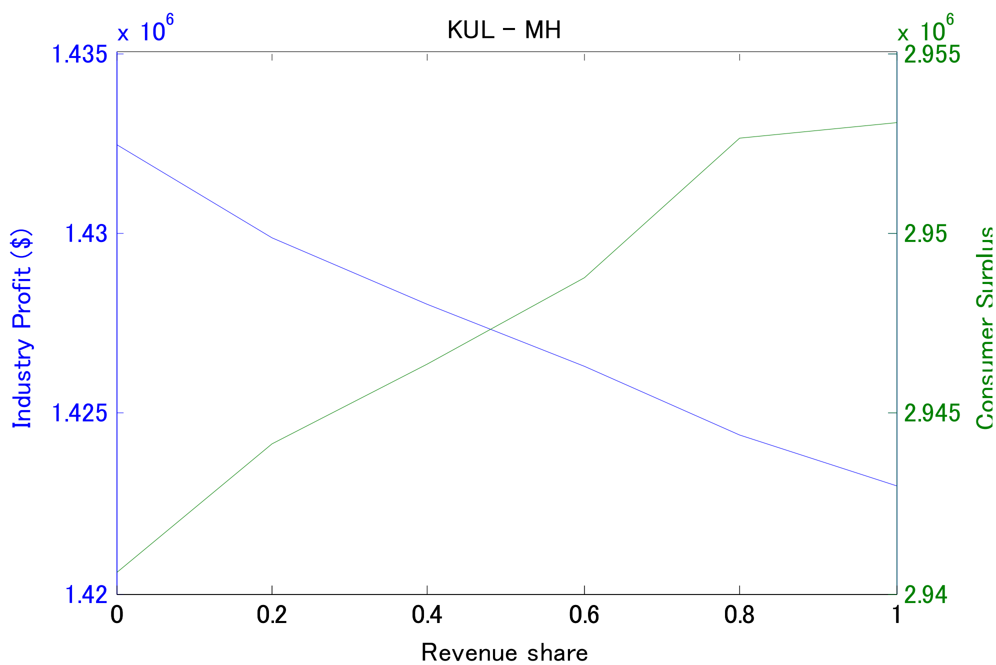


(b)

Industry Profit and Consumer Surplus when KUL sharing revenue with MH

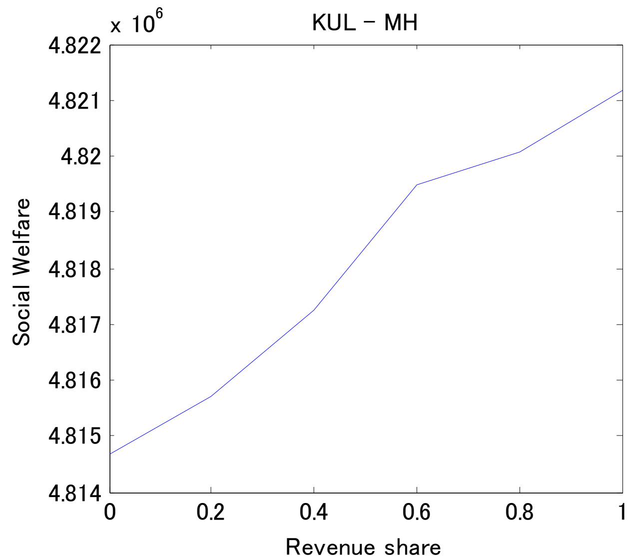


(a)

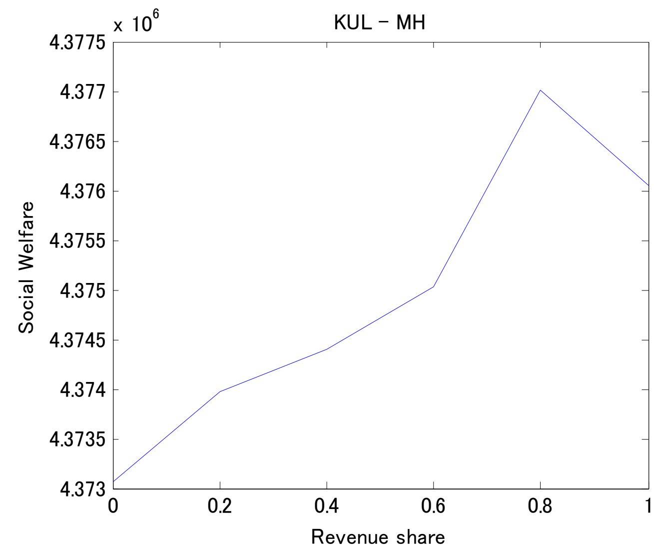


(b)

Social Welfare when KUL sharing revenue with MH



(a)



(b)

Revenue Share Allocation

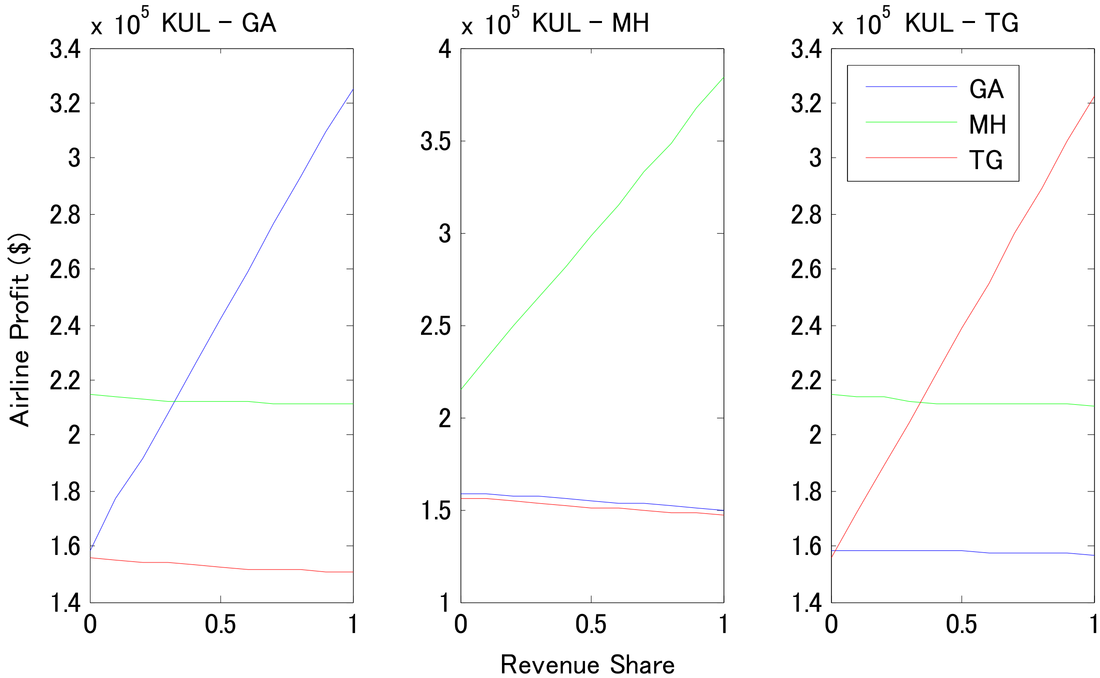
(a)

	Airport (n)	r_{in}^*			$\sum_i b_{in}$ (\$)	Airport Profit Π (\$)		
		MH	TG	GA		KUL	BKK	CGK
No cooperation		0	0	0	0	263,603	221,726	200,896
Case 1	KUL	0.95	0	0	162,513	**267,764**	222,867	201,835
Case 2	BKK	0	0.74	0	103,164	267,831	**224,499**	202,281
Case 3	CGK	0	0	0.87	125,007	267,846	224,692	**202,726**

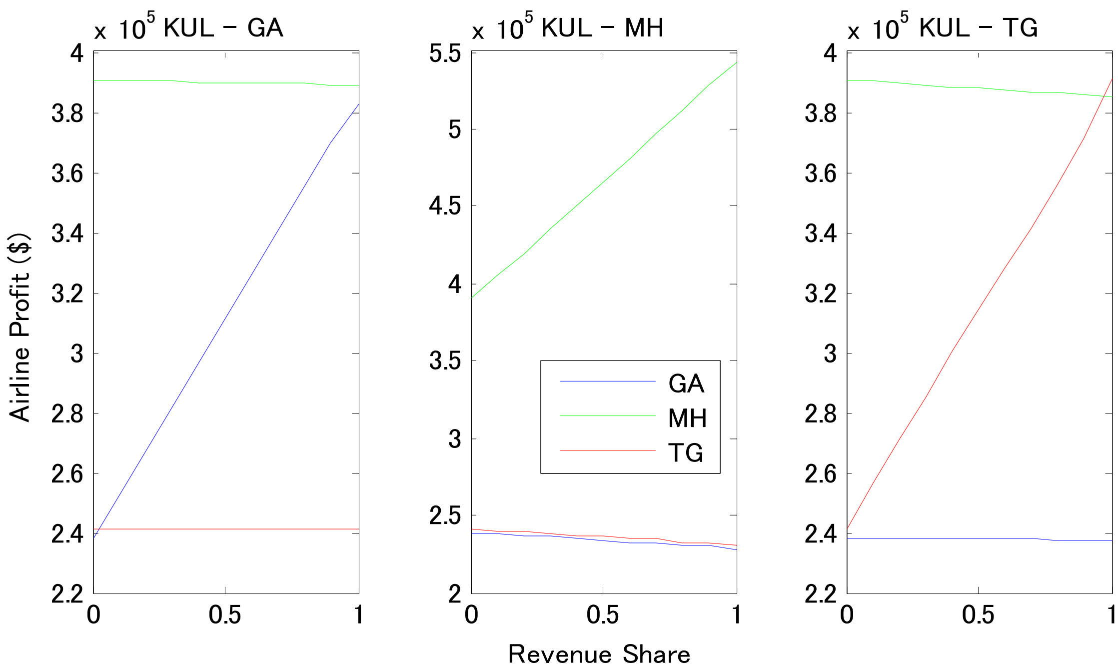
(b)

	Airport (n)	r_{in}^*			$\sum_i b_{in}$ (\$)	Airport Profit Π (\$)		
		MH	TG	GA		KUL	BKK	CGK
No cooperation		0	0	0	0	227,329	174,499	160,681
Case 1	KUL	1	0	0	153,361	**236,232**	175,372	161,430
Case 2	BKK	0	0.89	0	121,727	232,727	**195,769**	152,828
Case 3	CGK	0	0	0.72	78,655	232,719	195,896	**155,787**

Airline Profits when KUL sharing revenue with GA, MH and TG



(a)



(b)

APPENDIX C

Java Codes for Revenue Share Allocation Program (Chapter 3)

Program Revenue Share Allocation

```
import java.text.DecimalFormat;
public class mainPort2 {
       static int ConCheckAirport [];
       static int ConCheck [];
       static int iterAirport;
       static Airlines air;
       static DecimalFormat df;
       static double BestXAirPort [];
       static double zeta,sigma,nu,zetaold,sigmaold,nuold;
       static int iter;
       static double zeta2;
       static double eps;
       static double rho;
       static double Best [],output [];
       static int itermax;
       static double parC;
       static double round;
       static int cond;
       public static void main(String[] args) {
              df=new DecimalFormat("#.###");
              ConCheckAirport=new int [3];
              int sum =0;
              for (int i=0;i<2;i++){
                     ConCheckAirport[i]=1;
                     sum = sum + ConCheckAirport[i];
              }
              round=100000.0;
              iterAirport=0;
              air=new Airlines();
              parC=500000.0;
              zeta2=20.0;
              int count=0;
              int airl=1;
              output=new double[100];
              cond=0;

              double MaxMax=0.0;
              while (sum>0){
                     count=count+1;
                     System.out.println("     " +count + "    " +parC);
                     ConCheckAirport[0]=0;
                     for (int ii=0;ii<air.nair;ii++){
                            if (air.airlines[ii].rin[airl]<0.0 || air.airlines[ii].rin[airl]>1.0){
                                   ConCheckAirport[0]=1;
                                   break;
                            }
                 }

                 ConCheckAirport[1]=0;
                 double temp=0.0;
                 for (int ii=0;ii<air.nair;ii++){
                            temp=temp+air.airlines[ii].rin[airl];
                 }
                 if (temp>1){
                    ConCheckAirport[1]=1;
                 }

                 double Maxf=HookeJeevesAirPort(airl,iterAirport);
                 for (int j=0;j<air.nair;j++){
```

```
                air.airlines[j].rin[airl] = BestXAirPort[j];
            }
            ConCheckAirport[0]=0;
                for (int ii=0;ii<air.nair;ii++){
                        if (air.airlines[ii].rin[airl]<0.0 || air.airlines[ii].rin[airl]>1.0){
                                ConCheckAirport[0]=1;
                                break;
                        }
            }
            ConCheckAirport[1]=0;
            temp=0.0;
            for (int ii=0;ii<air.nair;ii++){
                        temp=temp+air.airlines[ii].rin[airl];
            }
            if (temp>1){
                ConCheckAirport[1]=1;
            }

            ConCheckAirport[2]=0;
            System.out.println("    " + MaxMax + "    " + Maxf);
            if(MaxMax-Maxf>0.0 && ConCheckAirport[0]==0 && ConCheckAirport[1]==0){
                parC=250000.0;
                        double tempx=air.airlines[airl].rin[airl];
                if(air.airlines[airl].rin[airl]==0.0){
                        air.airlines[airl].rin[airl]=0.5;

                }

                air.airlines[airl].rin[airl]=air.airlines[airl].rin[airl]+0.25;

                if(air.airlines[airl].rin[airl]>1.0){
                                                        air.airlines[airl].rin[airl]=0.5;

                }
                ConCheckAirport[2]=1;

            }
            else if (MaxMax-Maxf<0.0){
                output[iterAirport]=MaxMax;
                MaxMax=Maxf;
                                double tempx=air.airlines[airl].rin[airl];
                if(air.airlines[airl].rin[airl]==0.0){
                        air.airlines[airl].rin[airl]=0.5;

                }
                air.airlines[airl].rin[airl]=air.airlines[airl].rin[airl]+0.25;

                if(air.airlines[airl].rin[airl]>1.0){
                                                air.airlines[airl].rin[airl]=0.5;
                                        }
                ConCheckAirport[2]=1;
                iterAirport=iterAirport+1;
            }
            sum=0;
            for (int i=0;i<3;i++){
                sum=sum+ConCheckAirport[i];
            }
    public static void AirportObj(){
            loopPhase2(iterAirport);
            for (int w = 0;w<air.npot;w++){
                double term2 =0.0;
                for (int x = 0;x<air.nair;x++){
                        double term3 = 0.0;
                        for (int y = 0;y<air.na;y++){

                                        term3 =
term3+air.airlines[x].LCin[w]*air.airlines[x].fia[y]*air.parameterLamda3[w].and[y];
                        }
                        term2 = term2+term3;
```

```
				}
				Airport1[w] = term2;
			}
			for (int w = 0;w<air.npot;w++){
				double term1 = 0.0;
				for (int x = 0;x<air.nair;x++){
					double term2 = 0.0;
					for (int y = 0;y<air.nod;y++){
						for (int z = 0;z<air.nr;z++){
							double term3 =
air.airlines[x].PCin[w]*air.airlines[x].qimk[y][z]*air.parameterLamda6[y].mkno[w][z];
							term2 = term2 + term3;
						}
					}
					term1 = term1+term2;
				}
				Airport2[w]=term1;
			}
			for (int w = 0;w<air.npot;w++){
				double term1 = 0.0;
				for (int x = 0;x<air.nair;x++){
					double term2 = 0.0;
					for (int y = 0;y<air.nod;y++){
						for (int z = 0;z<air.nr;z++){
							double term3 =
air.airlines[x].PCtin[w]*air.airlines[x].qimk[y][z]*air.parameterLamda6[y].mknt[w][z];
							term2 = term2 + term3;
						}
					}
					term1 = term1+term2;
				}
				Airport3[w]=term1;
			}
			double AirportTS[]=new double [air.npot];
			for (int i=0;i<air.npot;i++){
				AirportTS[i]=Airport1[i]+Airport2[i]+Airport3[i];
			}
			for (int w=0;w<air.npot;w++){
				double term5 = 0.0;
				double temp2 = 0.0;
				double temp=0.0;
				for (int x=0;x<air.nair;x++){
					temp2 = temp2 + air.airlines[x].rin[w];
					temp=0.0;
					for (int xx = 0;xx<air.nair;xx++){
						for (int y = 0;y<air.nod;y++){
							for (int z = 0;z<air.nr;z++){
								temp = temp +
air.airlines[xx].qimk[y][z]*(air.parameterLamda6[y].mkno[w][z]+air.parameterLamda6[y].mknt[w][z]+ai
r.parameterLamda6[y].mknd[w][z])*air.airlines[xx].hin[w];
							}
						}
					}
				}
				term5 = term5 + temp*(1-temp2);
				Airport4[w]=term5;
			}
			double AirportCR[]=new double [air.npot];
			for (int i=0;i<air.npot;i++){
				AirportCR[i]=Airport4[i];
			}
			for (int i=0;i<air.npot;i++){
				air.ProfAirport[i]=AirportTS[i]+AirportCR[i];
			}
		}
		public static double PenaltyAirport (int port){
			AirportObj();
			double temp = 0.0;
			for (int qq=0;qq<air.nair;qq++){
```

```
                temp = temp + Math.pow(Math.max(0.0,((air.airlines[qq].rin[port]-1.0))),2.0);
        }
        double term2 = 0.0;
        double temp1 = 0.0;
        for (int j=0;j<air.nair;j++){
                temp1 = temp1 + air.airlines[j].rin[port];
        }
        term2 = term2 + Math.pow(Math.max(0.0,(temp1-1.0)),2.0);

        if(ConCheckAirport[0]==0){
                temp=0.0;
        }

        if(ConCheckAirport[1]==0){
                term2=0.0;
        }
        air.airlinesObj();

        for(int i=0;i<air.nair;i++){
                air.parameter.bin[i]=air.ProfAirline[i];
        }
        for(int i=0;i<air.nair;i++){
                if(air.airlines[i].rin[port]==0.0){
                        air.parameter.bin0[i]=air.parameter.bin[i];
                }
        }
        double sum2=0.0;
        for(int i=0;i<air.nair;i++){
                sum2=sum2+(air.parameter.bin[i]-air.parameter.bin0[i]);
        }
        air.LAirport[port] = (air.ProfAirport[port]+sum2) - parC*(temp + term2);
        return air.LAirport[port];
}
public static double HookeJeevesAirPort(int airl,int it){
        double MaxF=0.0;
        double RL [] = new double[3];
        double RU [] = new double [3];
        for (int i=0;i<3;i++){
                RL[i]=0.0;
                RU[i]=1.0;
        }
        BestXAirPort=new double [3];
        double fit [] = new double [6];
        for (int i = 0;i<air.npot;i++){
                BestXAirPort[i]=(double) Math.round(air.airlines[i].rin[airl]*round)/round;
        }
        double X []= new double [3];
        double BestXP []= new double [3];
        for (int i = 0;i<3;i++){
            X[i]=BestXAirPort[i];
        }
        double xp [][] = new double [6][3];
        double b [][] = new double [6][3];

        for(int i=0;i<6;i++){
                for(int j=0;j<3;j++){
                        xp[i][j]=0.0;
                }
        }
        for(int i=0;i<6;i++){
                if(i<3){
                        for(int j=0;j<3;j++){
                                if(i==j){
                                        b[i][j]=0.1;
                                }
                                else{
                                        b[i][j]=0.0;
                                }
                        }
```

```java
                }
                else{
                        for(int j=0;j<3;j++){
                                if(i-3==j){
                                        b[i][j]=-0.1;
                                }
                                else{
                                        b[i][j]=0.0;
                                }
                        }
                }
        }
        double ms []=new double[3];
        for(int i=0;i<3;i++){
                ms[i]=(RU[i]-RL[i]/1.0);
        }
        int g = 0;
        int conms1=0;
        for(int i=0;i<3;i++){
                if (ms[i]>0.05){
                        conms1=1;
                        break;
                }
        }
        while ( conms1!=0){
            g = g + 1;
            for(int i=0;i<3;i++){
               air.airlines[i].rin[airl]=(double) Math.round(X[i]*round)/round;

                }

            double fitness= PenaltyAirport(airl);
            MaxF=fitness;
            double MinF=fitness;
            double MaxFTemp=MaxF;
            for(int loop=0;loop<6;loop++){
               for(int j=0;j<3;j++){
                        xp[loop][j]=X[j]+ms[j]*b[loop][j];
                }

                double XP [] = new double[3];
                for(int k=0;k<3;k++){
                        XP[k]=xp[loop][k];
                }
                int con1 [] =new int[3];
                int con2 [] =new int[3];

                int sum1=0;
                int sum2=0;

                for(int k=0;k<3;k++){
                        if(xp[loop][k]>=RL[k]){
                                con1[k]=1;
                                sum1= sum1+con1[k];
                                }
                }
                        for(int k=0;k<3;k++){
                        if(xp[loop][k]<RU[k]){
                                con2[k]=1;
                                sum2=sum2+con2[k];
                                }
                }

                if(sum1==3 && sum2==3){
                        for(int ii=0;ii<3;ii++){
                                air.airlines[ii].rin[airl]=(double)
Math.round(XP[ii]*round)/round;
                                }
                            fit[loop]= PenaltyAirport(airl);
```

```
            }
            else{
                  fit[loop]=0.0;
            }
            if(fit[loop]-MaxF>800.0 && fit[loop]!=0.0){
                  MaxF=fit[loop];
                  for(int i=0;i<3;i++){
                        BestXP[i]=(double) Math.round(xp[loop][i]*round)/round;
                  }
            }
                        if(fit[loop]<MinF){
                  MinF=fit[loop];
            }
         }
         if(MaxF-MaxFTemp>800.0){
            for(int i=0;i<3;i++){
                  ms[i]=ms[i]*2.0;
            }
         }
         else{
            for(int i=0;i<3;i++){
                  ms[i]=ms[i]/2.0;
            }
         }
         if(MaxF-MaxFTemp>800.0){
            for(int i=0;i<3;i++){
                  X[i]=BestXP[i];
                  BestXAirPort[i]=(double) Math.round(BestXP[i]*round)/round;
            }
         }
         conms1=0;
         for(int i=0;i<3;i++){
                  if (ms[i]>0.05){
                        conms1=1;
                        break;
                  }
            }
      return MaxF;
}
static public void loopPhase2(int xx){

      for (int k=0;k<3;k++){
            for (int i=0;i<6;i++){
                  for(int j=0;j<2;j++){
                        air.airlines[k].temporary_pimk[i][j]=air.airlines[k].pimk[i][j];
                  }
            }
      }
      for (int k=0;k<3;k++){
            for (int i=0;i<6;i++){
                  air.airlines[k].temporary_fia[i]=air.airlines[k].fia[i];
            }
      }
      air.parameter.lagrange_tauia=new double [3][6];
      air.parameter.lagrange_etano=new double [3];
      air.parameter.lagrange_epsind=new double [3];
      air.parameter.lagrange_rho=1.0;
      for (int i=0;i<3;i++){
            for (int j=0;j<6;j++){
                  air.parameter.lagrange_tauia[i][j]=1.0;
            }
      }
      for (int i=0;i<3;i++){
            air.parameter.lagrange_etano[i]=1.0;
      }
      for (int i=0;i<3;i++){
            air.parameter.lagrange_epsind[i]=1.0;
      }
      ConCheck=new int [3];
```

```
            int sum =0;
            for (int i=0;i<3;i++){
                  ConCheck[i]=1;
                  sum = sum + ConCheck[i];
            }
            while (sum>0){
                  air.airLinesPassFlow();
                  upDateParLag();
                  zetaold=zeta;
                  sigmaold=sigma;
                  nuold=nu;
                  for (int q = 0;q<air.nair;q++){

                        for (int p = 0;p<air.nair;p++){
                              for (int r=0;r<air.nod;r++){
                                    for (int s=0;s<air.nr;s++){
                                          air.airlines[p].pimk[r][s] =
air.airlines[p].temporary_pimk[r][s];
                                    }
                              }
                        }
                        for (int p = 0;p<air.nair;p++){
                              for (int r=0;r<air.nod;r++){
                                    air.airlines[p].fia[r] = air.airlines[p].temporary_fia[r];
                              }
                        }
                        double MaxF=0.0;
                        MaxF=air.HookeJeevesAirline(q);
                        int count1=-1;
                        int count2=-1;
                        for (int i=0;i<18;i++){
                              if (i>5 && i<=11){
                                    count1=count1+1;
                              }
                              else if (i>11 && i<18){
                                    count2=count2+1;
                              }
                              if (air.BestXAirline[i]!=0){
                                    if (i<6){
                                          air.airlines[q].best_pimk[i][0]=air.BestXAirline[i];
                                    }
                                    else if (i>5 && i<=11){

      air.airlines[q].best_pimk[count1][1]=air.BestXAirline[i];
                                    }
                                    else{
                                          air.airlines[q].best_fia[count2]=air.BestXAirline[i];
                                    }
                              }
                        }
                  }
                  for (int p = 0;p<air.nair;p++){
                        for (int r=0;r<air.nod;r++){
                              for (int s=0;s<air.nr;s++){
                                    air.airlines[p].pimk[r][s] =
air.airlines[p].temporary_pimk[r][s];
                              }
                        }
                  }

                  for (int p = 0;p<air.nair;p++){
                        for (int r=0;r<air.nod;r++){
                              air.airlines[p].fia[r] = air.airlines[p].temporary_fia[r];
                        }
                  }
                  for (int p = 0;p<air.nair;p++){
                        for (int r=0;r<air.nod;r++){
                              for (int s=0;s<air.nr;s++){
```

```
                                        air.airlines[p].update_pimk[r][s] =
air.airlines[p].temporary_pimk[r][s] + (air.airlines[p].best_pimk[r][s] -
air.airlines[p].temporary_pimk[r][s])/(iter+1.0);
                                }
                        }
                }
                for (int p = 0;p<air.nair;p++){
                        for (int r=0;r<air.nod;r++){
                                air.airlines[p].update_fia[r] = air.airlines[p].temporary_fia[r] +
(air.airlines[p].best_fia[r] - air.airlines[p].temporary_fia[r])/(iter+1.0);
                        }
                }
                for (int p = 0;p<air.nair;p++){
                        for (int r=0;r<air.nod;r++){
                                for (int s=0;s<air.nr;s++){
                                        air.airlines[p].pimk[r][s] =
air.airlines[p].update_pimk[r][s];
                                }
                        }
                }
                for (int p = 0;p<air.nair;p++){
                        for (int r=0;r<air.nod;r++){
                                air.airlines[p].fia[r] = air.airlines[p].update_fia[r];

                        }
                for (int e = 0;e<air.nair;e++){
                        ConCheck[0] = air.Check();
                        if (ConCheck[0] == 1){
                                break;
                        }
                }
                ConCheck[1] = 0;
                double Con2[]=new double [air.npot];
                for (int q = 0;q<air.npot;q++){
                        double temp11 = 0.0;
                        for (int w = 0;w<air.nair;w++){
                                for (int x = 0;x<air.na;x++){
                                        temp11 = temp11 +
air.airlines[w].fia[x]*air.parameterLamda3[q].and[x];
                                }
                        }
                        Con2[q] = temp11;
                        if (temp11 >= air.parameter.ynd[q]){
                                ConCheck[1] = 1;
                                break;
                        }
                }
                ConCheck[2] = 0;
                double Con3[]=new double [air.npot];
                for (int q = 0;q<air.npot;q++){
                        double temp12 = 0.0;
                        for (int w = 0;w<air.nair;w++){
                                for (int x = 0;x<air.na;x++){
                                        temp12 = temp12 +
air.airlines[w].fia[x]*air.parameterLamda3[q].ano[x];
                                }
                        }
                        Con3[q] = temp12;
                        if (temp12 >= air.parameter.yno[q]){
                                ConCheck[2] = 1;
                                break;
                        }
                }
                sum=0;
                for (int i=0;i<3;i++){
                        sum = sum + ConCheck[i];
                }
                if (sum == 0){
                        break;
```

```
                    }
                    double tauianew[][]=new double [air.nair][air.na];
                    double epsinew[]=new double [air.nair];
                    double etanonew[]=new double [air.nair];

                    air.airLinesPassFlow();

                    for (int y = 0;y<air.nair;y++){
                          for (int z = 0;z<air.na;z++){
                                tauianew[y][z] = Math.max(0.0,(air.parameter.lagrange_tauia[y][z]
+ air.parameter.lagrange_rho*(air.airlines[y].qia[z] - air.airlines[y].sia[z] *
air.airlines[y].fia[z])));
                          }
                    }
                    for (int z = 0;z<air.npot;z++){
                          epsinew[z] = Math.max(0.0,(air.parameter.lagrange_epsind[z] +
air.parameter.lagrange_rho*(Con2[z] - air.parameter.ynd[z])));
                    }
                    for (int z = 0;z<air.npot;z++){
                          etanonew[z] = Math.max(0.0,(air.parameter.lagrange_etano[z] +
air.parameter.lagrange_rho*(Con3[z] - air.parameter.yno[z])));
                    }

                    for (int y = 0;y<air.nair;y++){
                          for (int z = 0;z<air.na;z++){
                                air.parameter.lagrange_tauia[y][z]=tauianew[y][z];
                          }
                    }
                    for (int z = 0;z<air.npot;z++){
                          air.parameter.lagrange_epsind[z]=epsinew[z];
                    }

                    for (int z = 0;z<air.npot;z++){
                          air.parameter.lagrange_etano[z]=etanonew[z];
                    }

                    upDateParLag();

                    if (Math.sqrt(zeta + sigma + nu) > 0.25*Math.sqrt(zetaold + sigmaold + nuold)){
                          air.parameter.lagrange_rho = 6.0*air.parameter.lagrange_rho;
                    }
                    else{
                          air.parameter.lagrange_rho = air.parameter.lagrange_rho;
                    }
                    iter = iter+1;
                    for (int p = 0;p<air.nair;p++){
                          for (int r=0;r<air.nod;r++){
                                for (int s=0;s<air.nr;s++){
                                      air.airlines[p].temporary_pimk[r][s] =
air.airlines[p].update_pimk[r][s];
                                }
                          }
                    }
                    for (int p = 0;p<air.nair;p++){
                          for (int r=0;r<air.nod;r++){
                                air.airlines[p].temporary_fia[r] = air.airlines[p].update_fia[r];
                          }
                    }
              }
        }
        public static void upDateParLag(){
              double Con2[]=new double [air.npot];
              for (int q = 0;q<air.npot;q++){
                    double temp11 = 0.0;
                    for (int w = 0;w<air.nair;w++){
                          for (int x = 0;x<air.na;x++){
                                temp11 = temp11 +
air.airlines[w].fia[x]*air.parameterLamda3[q].and[x];
                          }
```

```
                    }
                    Con2[q] = temp11;
            }
            double Con3[]=new double [air.npot];
            for (int q = 0;q<air.npot;q++){
                    double temp12 = 0.0;
                    for (int w = 0;w<air.nair;w++){
                            for (int x = 0;x<air.na;x++){
                                    temp12 = temp12 +
air.airlines[w].fia[x]*air.parameterLamda3[q].ano[x];
                            }
                    }
                    Con3[q] = temp12;
            }
            double temp13 = 0.0;
            for (int y = 0;y<air.nair;y++){
                    for (int z = 0;z<air.na;z++){
                            temp13 = temp13 + Math.pow(Math.max((-
air.parameter.lagrange_tauia[y][z]/air.parameter.lagrange_rho), (air.airlines[y].qia[z] -
air.airlines[y].sia[z] * air.airlines[y].fia[z])),2.0);
                    }
            }
            zeta = temp13;
            double temp21 = 0.0;
            for (int e = 0;e<air.npot;e++){
                    temp21 = temp21 + Math.pow(Math.max((-
air.parameter.lagrange_epsind[e]/air.parameter.lagrange_rho),Con2[e]-air.parameter.ynd[e]),2.0);
            }
            sigma = temp21;
            double temp31 = 0.0;
            for (int e = 0;e<air.npot;e++){
                    temp31 = temp31 + Math.pow(Math.max((-
air.parameter.lagrange_etano[e]/air.parameter.lagrange_rho),Con3[e]-air.parameter.yno[e]),2.0);
            }
            nu = temp31;
    }
}
```

Program Airline Market Share, Airline Profit, and Airport Profit

```
import java.text.DecimalFormat;
public class Airlines2 {
	InputVariables airlines[];
	InputVariables parameter
	InputVariables [] parameterLamda6;
	InputVariables [] parameterLamda3;
	double ProfAirline [];
	double LAirline[];
	double LAirport[];
	double BestXAirline[];
	double BestXAirport[];
	double ProfAirport [];
	InputVariables parameterq0;
	final static int nair = 3;
	final static int nod = 6;
	final static int nr = 2;
	final static int na  = 6;
	final static int npot = 3;
	DecimalFormat df;
	public Airlines2(double a11, double a12,double a13,double a21,double a22,double a23, double 
a31, double a32, double a33){
		airlines=new InputVariables[3];
		ProfAirline = new double [3];
		LAirline = new double [3];
		LAirport = new double [3];
		ProfAirport= new double [3];
		for (int i=0;i<nair;i++){
			airlines[i]=new InputVariables();
		}
		parameterq0=new InputVariables();
		parameter=new InputVariables();
		parameterLamda6=new InputVariables[6];
		for (int i=0;i<nod;i++){
			parameterLamda6[i]=new InputVariables();
		}
		parameterLamda3=new InputVariables[3];
		for (int i=0;i<nair;i++){
			parameterLamda3[i]=new InputVariables();
		}
		for (int k=0;k<3;k++){
			for (int i=0;i<6;i++){
				for(int j=0;j<2;j++){
					airlines[k].temporary_pimk[i][j]=airlines[k].pimk[i][j];
				}
			}
		}
		for (int k=0;k<3;k++){
			for (int i=0;i<6;i++){
				airlines[k].temporary_fia[i]=airlines[k].fia[i];
			}
		}
		for (int k=0;k<3;k++){
			for (int i=0;i<3;i++){
				airlines[k].temporary_rin[i]=airlines[k].rin[i];
			}
		}
		df=new DecimalFormat("#.###");
	}
	public void airLinesPassFlow(){
		for(int i=0;i<nair;i++){
			for(int j=0;j<nod;j++){
				if (airlines[i].fia[j]!=0.0){
					airlines[i].dia[j] = parameter.T/(4.0*airlines[i].fia[j]);
				}
		for (int w = 0;w<nair;w++){
			for (int x = 0;x<nod;x++){
```

```
                        for (int y = 0;y<nr;y++){
                                airlines[w].dimk[x][y] = 0.0;
                        }
                }
        }

        for (int w = 0;w<nair;w++){
                for (int x = 0;x<nod;x++){
                        for (int y = 0;y<nr;y++){
                                for (int z = 0;z<na;z++){

                                        double term =
((airlines[w].dia[z])*(parameterLamda6[x].mka[z][y]));
                                        airlines[w].dimk[x][y] = airlines[w].dimk[x][y]+term;
                                }
                        }
                }
        }
        for (int w=0;w<nair;w++){
                for (int x = 0;x<nod;x++){
                        for (int y = 0;y<nr;y++){
                                if (airlines[w].diax[x][y] == 0){
                        airlines[w].dimk[x][y] = 0.0;
                    }
                        }
                                        }
        }
        double term=0.0;
        for (int w=0;w<nair;w++){
                for (int x = 0;x<nod;x++){
                        for (int y = 0;y<nr;y++){

                                airlines[w].timk[x][y] =0.0;
                        }
                }
        }
        for (int w=0;w<nair;w++){
                for (int x = 0;x<nod;x++){
                        for (int y = 0;y<nr;y++){
                                for (int z = 0;z<na;z++){
                                        term =
((airlines[w].tia[z])*(parameterLamda6[x].mka[z][y]));
                                        airlines[w].timk[x][y] = airlines[w].timk[x][y]+term;
                                }
                        }
                                        }
                                }
        for (int w=0;w<nair;w++){
                for (int x=0;x<nod;x++){
                        for (int y=0;y<nr;y++){
                                if (airlines[w].diax[x][y] == 0){
                                        airlines[w].timk[x][y] = 0.0;
                                }
                        }
                }
        }
        for (int w=0;w<nair;w++){
                for (int i =0;i<nod;i++){
                        for(int j=0;j<nr;j++){

                                airlines[w].uimk[i][j] =
parameter.alphavot*(airlines[w].timk[i][j] + parameter.alpha*airlines[w].dimk[i][j] +
airlines[w].trimk[i][j]) + airlines[w].pimk[i][j];
                        }
                }
        }

        for (int w=0;w<nair;w++){
                for (int x=0;x<nod;x++){
```

```
                        for (int y = 0;y<nr;y++){
                                if (airlines[w].diax[x][y] == 0){
                                        airlines[w].uimk[x][y] = 0.0;
                                }
                        }
                }
        }
        double psim[]=new double [nod];
        for (int w=0;w<nod;w++){
                double term2 =0.0;
                for (int x=0;x<nair;x++){
                        term = 0.0;
                        for (int y=0;y<nr;y++){
                                double term3 = Math.exp(-parameter.theta*airlines[x].uimk[w][y]);
                                if (term3 == 1.0){
                                        term3 = 0.0;
                                }
                                term = term + term3;
                        }
                        term2 = term2+term;
                }
                psim[w] = -(1.0/parameter.theta)*Math.log(term2);
        }
        double qm[]=new double [nod];
        for (int i=0;i<nod;i++){
                qm[i]=parameter.q0[i]*Math.exp(-parameter.beta*psim[i]);
        }
        for (int w=0;w<nair;w++){
                for (int e=0;e<nod;e++){
                        for (int r=0;r<nr;r++){
                                double term2 = 0.0;
                                for (int x = 0;x<nair;x++){
                                        term = 0;
                                        for (int y = 0;y<nr;y++){
                                                double term3 = Math.exp(-
parameter.theta*airlines[x].uimk[e][y]);
                                                if (term3 == 1.0){
                                                        term3 = 0.0;
                                                }
                                                term = term + term3;
                                        }
                                        term2 = term2+term;
                                }
                                airlines[w].qimk[e][r] = qm[e]*Math.exp(-
parameter.theta*airlines[w].uimk[e][r])/term2;
                        }
                }
        }
        for (int w=0;w<nair;w++){
                for (int x=0;x<nod;x++){
                        for (int y = 0;y<nr;y++){
                                if (airlines[w].diax[x][y] == 0){
                                        airlines[w].qimk[x][y] = 0.0;
                                }
                        }
                }
        }
        for (int w= 0;w<nair;w++){
                for (int x=0;x<na;x++){
                        airlines[w].qia[x] = 0.0;
                        for (int y = 0;y<nod;y++){
                                for (int z = 0;z<nr;z++){
                                        airlines[w].qia[x] = airlines[w].qia[x] +
airlines[w].qimk[y][z]*parameterLamda6[y].mka[x][z];
                                }
                        }
                }
        }
}
```

```
	public void airlinesObj(){
		airLinesPassFlow();
		for (int air=0;air<nair;air++){
			double term6 = 0.0;
		for (int b = 0;b<nod;b++){
			double term1 = 0.0;
			for (int j = 0;j<nr;j++){
				term1 = term1+airlines[air].pimk[b][j]*airlines[air].qimk[b][j];
				double term4 = 0.0;
				for (int p=0;p<npot;p++){
					term4 = term4 +
airlines[air].PCin[p]*airlines[air].qimk[b][j]*parameterLamda6[b].mkno[p][j] +
airlines[air].PCtin[p]*airlines[air].qimk[b][j]*parameterLamda6[b].mknt[p][j];
				}
				double TotalTerm = term1-term4;
				if (airlines[air].diax[b][j] == 0){
					TotalTerm = 0.0;
				}
				term6 = term6 + TotalTerm;
			}
		}
		double term2 = 0.0;
		for (int l=0;l<na;l++){
			term2 = term2 + airlines[air].cia[l]*
airlines[air].fia[l]*parameter.parameters_Da[l]*airlines[air].sia[l];
		}
		double term3 = 0.0;
		for (int l=0;l<na;l++){
			for (int p=0;p<npot;p++){
			term3 = term3 +
airlines[air].LCin[p]*airlines[air].fia[l]*parameterLamda3[p].and[l];
			}
		}
		double term5 = 0.0;
		for (int p=0;p<npot;p++){
			double temp2 = airlines[air].rin[p]*airlines[air].hin[p];
			double temp = 0.0;
			for (int x = 0;x<nair;x++){
				for (int y = 0;y<nod;y++){
					for (int z = 0;z<nr;z++){
						temp = temp +
airlines[x].qimk[y][z]*(parameterLamda6[y].mkno[p][z]+parameterLamda6[y].mknt[p][z]+parameterLamda6
[y].mknd[p][z]);
					}
				}
			}
			term5 = term5 + temp*temp2;
		}
		ProfAirline[air] = term5 + term6 - term2- term3;
		}
	}
	public double AirlineLagrange(int airl){
		airlinesObj();
		double temp = 0.0;
		double rho=1.0;
		for (int q=0;q<na;q++){
			double xx=parameter.lagrange_tauia[airl][q]+rho*(airlines[airl].qia[q]-
airlines[airl].sia[q]*airlines[airl].fia[q]);
			temp = temp + Math.pow(Math.max(0.0,xx),2.0)-
Math.pow(parameter.lagrange_tauia[airl][q],2.0);
		}
		double term1 = temp;
		double term2 = 0.0;
		for (int t=0;t<npot;t++){
		    double temp11 = 0.0;
		    for (int j=0;j<nair;j++){
		        for (int k=0;k<na;k++){
		            temp11 = temp11 + airlines[j].fia[k]*parameterLamda3[t].and[k];
		        }
```

```
                  }
                  term2 = term2 + Math.pow(Math.max(0.0,parameter.lagrange_epsind[t] +
parameter.lagrange_rho*(temp11-parameter.ynd[t])),2.0)-Math.pow(parameter.lagrange_epsind[t],2.0);
                         }
              double term3 = 0.0;
              for (int t=0;t<npot;t++){
                  double temp12 = 0.0;
                  for (int j=0;j<nair;j++){
                      for (int k = 0;k<na;k++){
                          temp12 = temp12 + airlines[j].fia[k]*parameterLamda3[t].ano[k];
                      }
                  }
                  term3 = term3 + Math.pow(Math.max(0.0,parameter.lagrange_etano[t] +
parameter.lagrange_rho*(temp12-parameter.yno[t])),2.0)-Math.pow(parameter.lagrange_etano[t],2.0);
                         }
              LAirline[airl] =(ProfAirline[airl] - (1.0/(2.0*rho))*(term1 + term2 + term3));
              return LAirline[airl];
       }
       public double HookeJeevesAirline(int airl,int it){
              double MaxF=0.0;
              double RL [] = new double[18];
              double RU [] = new double [18];
              for (int i=0;i<18;i++){
                     RL[i]=0.0;
              }
              int count=0;
              for (int i = 0;i<2;i++){
                     for(int j=0;j<6;j++){
                            RU[count]=1000.0;
                            count=count+1;
                     }
              }
              for(int i=0;i<6;i++){
                     RU[count]=50.0;
                     count=count+1;
              }
              BestXAirline=new double [18];
              double fit [] = new double [36];
              count=0;
              for (int i = 0;i<2;i++){
                     for(int j=0;j<6;j++){
                            BestXAirline[count]=airlines[airl].pimk[j][i];
                            count=count+1;
                     }
              }
              for(int i=0;i<6;i++){
                     BestXAirline[count]=airlines[airl].fia[i];
                     count=count+1;
              }
              double X []= new double [18];
              double BestXP []= new double [18];
              for (int i = 0;i<18;i++){
                  X[i]=BestXAirline[i];
              }
              double xp [][] = new double [36][18];
              double b [][] = new double [36][18];

              for(int i=0;i<36;i++){
                     for(int j=0;j<18;j++){
                            xp[i][j]=0.0;
                     }
              }
              for(int i=0;i<36;i++){
                     if(i<18){
                            for(int j=0;j<18;j++){
                                   if(i==j){
                                          b[i][j]=1.0;
                                   }
                                   else{
```

```
                    b[i][j]=0.0;
                }
            }
        }
        else{
            for(int j=0;j<18;j++){
                if(i-18==j){
                    b[i][j]=-1.0;
                }
                else{
                    b[i][j]=0.0;
                }
            }
        }
    }
    double ms []=new double[18];
    for(int i=0;i<18;i++){
        ms[i]=(RU[i]-RL[i])/50.0;
    }
    int g = 0;
    int conms1=0;
    int conms2=0;
    for(int i=0;i<12;i++){
        if (ms[i]>0.05){
            conms1=1;
            break;
        }
    }
    for(int i=0;i<6;i++){
        if (ms[i+12]>0.05){
            conms2=1;
            break;
        }
    }
    while (conms1!=0 && conms2!=0 ){
       g = g + 1;
       int count1=-1;
       int count2=-1;
       for(int i=0;i<18;i++){
              if (i>5 && i<=11){
               count1=count1+1;
           }
           else if (i>11 && i<18){
               count2=count2+1;
           }
              if (X[i]!=0.0){
                  if (i<6){
                      airlines[airl].pimk[i][0]=X[i];
                  }
                  else if (i>5 && i<=11){
                      airlines[airl].pimk[count1][1]=X[i];
                  }
                  else{
                      airlines[airl].fia[count2]=X[i];
                  }
              }
        }
       double fitness= AirlineLagrange(airl)
       MaxF=fitness;
       double MinF=fitness;
       double MaxFTemp=MaxF;
       int BestIndex=0;
       for(int loop=0;loop<36;loop++){
          for(int j=0;j<18;j++){
              if (X[j]!=0.0){
                  xp[loop][j]=X[j]+ms[j]*b[loop][j];
              }
          }
          double XP [] = new double[18];
```

```
    for(int k=0;k<18;k++){
            if(X[k]!=0.0){
                    XP[k]=xp[loop][k];
            }
    }
    int con1 [] =new int[18];
    int con2 [] =new int[18];
    int sum1=0;
    int sum2=0;
    for(int k=0;k<18;k++){
            if(xp[loop][k]<RL[k]){
                    con1[k]=1;
                    sum1= sum1+con1[k];
                                                    }
    }
    for(int k=0;k<18;k++){
            if(xp[loop][k]>RU[k]){
                    con2[k]=1;
                    sum2=sum2+con2[k];
                                                    }
    }
    if(sum1!=18 && sum2!=18){
            int count11=-1;
                int count21=-1;
                for(int ii=0;ii<18;ii++){
                          if (ii>5 && ii<=11){
                           count11=count11+1;
                       }
                       else if (ii>11 && ii<18){
                           count21=count21+1;
                       }
                          if (XP[ii]!=0.0){
                                  if (ii<6){
                                          airlines[airl].pimk[ii][0]=XP[ii];
                                  }
                                  else if (ii>5 && ii<=11){

                                          airlines[airl].pimk[count11][1]=XP[ii];
                                  }
                                  else{
                                          airlines[airl].fia[count21]=XP[ii];
                                  }
                          }
                  }
                fit[loop]= AirlineLagrange(airl);
                BestIndex=BestIndex+1;;
                //System.out.println(+ fit[loop]);
    }
    else{
            fit[loop]=0.0;
    }
    if(fit[loop]>MaxF){
            MaxF=fit[loop];
            for(int i=0;i<18;i++){
                    BestXP[i]=xp[loop][i];
            }
    }
    if(fit[loop]<MinF){
            MinF=fit[loop];
    }
}
if(MaxF>MaxFTemp){
    for(int i=0;i<18;i++){
            ms[i]=ms[i]*2.0;
    }
}
else{
    for(int i=0;i<18;i++){
            ms[i]=ms[i]/2.0;
```

```
                }
            }
            if(MaxF>MaxFTemp){
                for(int i=0;i<18;i++){
                        X[i]=BestXP[i];
                        BestXAirline[i]=BestXP[i];
                }
            }
            conms1=0;
            conms2=0;
            for(int i=0;i<12;i++){
                        if (ms[i]>0.05){
                                conms1=1;
                                break;
                        }
                }

                for(int i=0;i<6;i++){
                        if (ms[i+12]>0.05){
                                conms2=1;
                                break;
                        }
                }
        }
        return MaxF;
    }
    public int Check(){
        airLinesPassFlow();
        int ConCheck = 0;
        for (int w = 0;w<nair;w++){
            for (int x = 0;x<na;x++){
                double ax=airlines[w].qia[x];
                double bx=airlines[w].fia[x];
                if (ax!=0 && bx!=0){
                    if (airlines[w].qia[x] >= airlines[w].sia[x]*airlines[w].fia[x]){
                        ConCheck = ConCheck + 1;
                    }
                }
            }
        }
        if (ConCheck > 0){
            ConCheck = 1;
        }
        return ConCheck;
    }
    public  void AirportObj(){
        for (int w = 0;w<npot;w++){
                double term2 =0.0;
                for (int x = 0;x<nair;x++){
                        double term3 = 0.0;
                        for (int y = 0;y<na;y++){
                                        term3 =
term3+airlines[x].LCin[w]*airlines[x].fia[y]*parameterLamda3[w].and[y];
                        }
                        term2 = term2+term3;
                }
                Airport1[w] = term2;
        }
        for (int w = 0;w<npot;w++){
                double term1 = 0.0;
                for (int x = 0;x<nair;x++){
                        double term2 = 0.0;
                        for (int y = 0;y<nod;y++){
                                for (int z = 0;z<nr;z++){
                                        double term3 =
airlines[x].PCin[w]*airlines[x].qimk[y][z]*parameterLamda6[y].mkno[w][z];
                                        term2 = term2 + term3;
                                }
                        }
```

```
                        term1 = term1+term2;
                }
                Airport2[w]=term1;

        }
        for (int w = 0;w<npot;w++){
                double term1 = 0.0;
                for (int x = 0;x<nair;x++){
                        double term2 = 0.0;
                        for (int y = 0;y<nod;y++){
                                for (int z = 0;z<nr;z++){
                                        double term3 =
airlines[x].PCtin[w]*airlines[x].qimk[y][z]*parameterLamda6[y].mknt[w][z];
                                        term2 = term2 + term3;
                                }
                        }
                        term1 = term1+term2;
                }
                Airport3[w]=term1;

        }
        double AirportTS[]=new double [npot];
        for (int i=0;i<npot;i++){
                AirportTS[i]=Airport1[i]+Airport2[i]+Airport3[i];
        }
        for (int w=0;w<npot;w++){
                double term5 = 0.0;
                double temp2 = 0.0;
                double temp=0.0;
                for (int x=0;x<nair;x++){
                        temp2 = temp2 + airlines[x].rin[w];
                        temp=0.0;
                        for (int xx = 0;xx<nair;xx++){
                                for (int y = 0;y<nod;y++){
                                        for (int z = 0;z<nr;z++){
                                                temp = temp +
airlines[xx].qimk[y][z]*(parameterLamda6[y].mkno[w][z]+parameterLamda6[y].mknt[w][z]+parameterLamda
6[y].mknd[w][z])*airlines[xx].hin[w];
                                        }
                                }
                        }
                }
                term5 = term5 + temp*(1-temp2);
                Airport4[w]=term5;
                                }
        double AirportCR[]=new double [npot];
        for (int i=0;i<npot;i++){
                AirportCR[i]=Airport4[i];
                        }
        for (int i=0;i<npot;i++){
                double sum2=0.0;
                for(int j=0;j<nair;j++){
                        sum2=sum2+parameter.bin[i];
                }
                ProfAirport[i]=AirportTS[i]+AirportCR[i];
                                }

    }
}
```

APPENDIX D

Data on Airport Incentive Schemes (Chapter 5)

Int. Airports	Incen-tives [(a)]	Traffic (2011, 2012)	Hub[(b)]	Ownership [(c)]	GDP	AirAsia traffic [(d)]	Airport competition [(e)]	HHI [(f)]
CGK	1	57,772,762	1	1	34,152,885	12	0.0152	0.2445
BKK	1	53,002,328	1	1	90,215,580	0	0.0477	0.1439
SIN	1	51,181,804	1	1	274,678,208	17	0.0489	0.0991
KUL	1	39,887,866	1	0	94,976,700	83	0.0548	0.2534
SUB	1	16,447,912	1	1	17,247,132	11	0.0175	0.2874
DMK	1	15,560,000	1	1	90,215,580	40	0.0465	0.4336
DPS	1	12,780,563	1	1	6,301,800	11	0.0162	0.1790
KNO	1	10,280,122	1	1	11,309,140	8	0.0096	0.3571
HKT	1	9,541,552	1	1	3,033,710	7	0.0264	0.1031
UPG	1	7,456,381	1	1	10,444,200	6	0.0044	0.3716
BKI	1	5,848,135	1	0	17,207,173	17	0.001	0.3845
BPN	1	5,680,961	1	1	4,690,300	2	0.0035	0.3075
PEN	1	4,767,815	1	0	16,226,137	11	0.0339	0.1305
CNX	1	4,491,331	0	1	4,584,748	7	0.0202	0.1657
JOG	1	4,291,646	0	1	7,584,658	4	0.0359	0.3246
KCH	1	4,186,523	0	0	25,576,974	8	0.0066	0.4515
BTH	1	3,762,352	1	1	3,906,305	0	0.0208	0.3335
BDJ	0	3,013,191	0	1	5,845,112	0	0.0028	0.3859
PLM	1	2,892,944	0	1	14,900,000	1	0.0094	0.3163
PKU	1	2,756,558	0	1	9,968,400	3	0.0116	0.2940
SRG	0	2,432,511	0	1	10,146,000	3	0.0272	0.2953
PNK	1	2,274,300	0	1	6,623,265	0	0.0042	0.2125
PDG	1	2,270,354	0	1	7,753,600	1	0.0101	0.2605
REP	1	2,223,029	0	0	1,792,000	2	0.026	0.1184
HDY	1	2,127,483	0	1	6,117,924	3	0.0318	0.3520
PNH	1	2,077,282	1	0	5,500,000	2	0.0228	0.0689
BWN	1	2,023,004	1	1	16,953,782	1	0.0075	0.5848
MYY	0	2,018,415	0	0	25,576,974	6	0.0073	0.6734
MDC	1	1,820,629	0	1	2,724,000	0	0.0023	0.4236
BDO	1	1,763,867	0	1	6,075,470	7	0.0153	0.3080
LOP	1	1,676,921	0	1	4,320,000	1	0.0091	0.4444
LGK	1	1,594,106	0	0	8,059,467	3	0.001	0.3147
JHB	0	1,470,000	0	1	21,778,920	9	0.0383	0.3049
SZB	1	1,442,514	0	0	53,238,604	0	0.0503	0.5162
PGK	0	1,325,522	0	1	2,010,612	0	0.0058	0.4063
KBR	0	1,259,205	1	0	3,960,957	2	0.0245	0.2472

Int. Airports	Incen-tives [(a)]	Traffic (2011, 2012)	Hub [(b)]	Ownership [(c)]	GDP	AirAsia traffic	Airport competition [(d)]	HHI [(e)]
SOC	1	1,195,812	0	1	11,679,000	1	0.0383	0.2375
KOE	0	1,174,928	0	1	2,435,160	0	0.0019	0.4548
DJB	1	1,014,963	0	1	5,772,764	0	0.0107	0.3750
CEI	1	986,436	0	1	2,090,287	1	0.019	0.3249
MKZ	0	34,355	0	0	6,296,140	0	0.0377	0.3211
AMQ	0	817,666	0	1	809,424	0	0.0031	0.5348
KBV	0	769,255	0	1	1,912,036	4	0.0298	0.2634
UBP	0	734,189	0	1	2,380,772	1	0.0219	0.4167
BTJ	1	705,719	0	1	8,156,610	1	0.0063	0.3132
UTH	0	677,411	0	1	2,355,567	2	0.0203	0.2639
BIK	0	366,385	0	1	296,100	0	0.0013	0.5679
TNJ	0	231,388	0	1	2,350,600	0	0.0055	0.3333
IPH	0	73,354	0	0	11,754,019	0	0.0341	1.0000
UTP	0	34,355	0	1	1,345,896	0	0.03	1.0000
KOS	1	13,865	0	0	132,440	0	0.0214	1.0000

Note:

(a) 1 = Incentive scheme is offered at airport; 0 = Incentive scheme is not offered at airport

(b) 1 = Airport is a hub; 0 = Airport is not a hub

(c) 1 = Airport is government-owned (public entities > 50%); 0 = Airport is private-owned

(d) AirAsia traffic denotes the number of destination offered by AirAsia in each respective airport.

(e) Airport competition is calculated by summing inverse driving distances (in kilometer) between one airport and the other 50 airports. Driving distance data is obtained from Google Map.

(f) Herfindahl–Hirschman Index (HHI) is calculated based on weekly flight frequency share on airport (9 December 2013 – 15 December 2013 for airports in Indonesia, Thailand, Cambodia, Singapore, Malaysia and Brunei; and 27 January 2014 – 2 February 2014 for airports in Laos, Vietnam, Myanmar and Philippines). The weekly flight frequency data is obtained from CAPA database.

APPENDIX E

Interviewee Lists – Indonesia Airports and Airlines (Chapter 4)

No	Organization	Position	Interviewee Name
1	Indonesia National Air Carriers Association (INACA)	Head of Research Division	Wismono Nitidihardjo
2	Angkasa Pura I	Head of Aviation Marketing Group	M. Asrori
3	Angkasa Pura II	Head of Aviation Marketing Group	Fery Utameyasa
4	Directorate General of Civil Aviation (DGCA)	Director of Airports Division	Bambang Tjahjono
5	Batam Airport	Head of Aviation Marketing	Dendi Gustinandar
6	Lion Air	Chief Representative of Batam Office	Ridho Silaen
7	Garuda Indonesia	Senior Manager Alliance and International Affairs	Nana Haryana

Contact information (phone number and/or email address) of the interviewees are available upon request.