THE EFFECTIVENESS OF DUTCH AIR TRANSPORT POLICY

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TABLE OF CONTENTS

Page

Executive Summary

The Netherlands Directorate General of Civil Aviation has asked *The Brattle Group* to assist them in evaluating the effectiveness of Dutch air transport policy. In particular, the Directorate General seeks research that analyses the following questions:

1. What has been the economic impact, in terms of accessibility by air and economic spin off, of the Dutch liberal air transport policy up till now?

2. Has the forefront position in Open Skies relations been advantageous in the end? Did the forefront position have any negative effects and/or were the positive effects by far more important?

Using aviation industry data and economic reasoning, this study offers analyses useful in answering the above questions.

Section 2 discusses the methodology for answering each of the above policy questions, while Section 3 discusses the likely qualitative effects of aviation liberalisation based on the economic theory of international trade. Sections 4 through 7 describe our results in detail, and Section 8 offers concluding remarks.

Past Findings

Past research suggests that the Netherlands' liberal air transport policy has been effective, specifically the pioneering 1992 Open Skies agreement between the Netherlands and the United States. That agreement made it possible for KLM and Northwest Airlines to obtain antitrust immunity for their alliance—the first alliance to gain such protection. Most of the prior research in the area has not attempted a comprehensive analysis of Dutch liberalisation in general, nor have statistical methods, such as regression analysis, been employed to separate the impact of liberalisation from other economic factors affecting passenger traffic.[1]

Methodology for Measuring the Economic Effects of Liberalisation

Several studies have relied on descriptive measures to conclude that the Netherlands-US Open Skies agreement, and the KLM-Northwest alliance arising from the agreement, have been very successful. However, an analysis of the economic impact of Dutch aviation policy requires a more formal methodology than that employed previously.

This report examines the impact of Dutch aviation policy using different analytic techniques, as described generally in Section 2. We compare market performance data before and after liberalisation. In addition, we use regression techniques to isolate the impact of aviation liberalisation from effects on passenger traffic that are attributable to changes in market cost and demand conditions. The analysis also compares the

[1] RAND Europe produced a report for the Netherlands Ministry of Transport and Water Management in May 1999 titled "Impact of Open Skies Treaty: US-The Netherlands." This report did not employ any statistical analyses to separate the impacts of liberalisation from any general economic effects.

performance of countries that have liberalised their aviation policy with the Netherlands and those that have not liberalised.

We focus substantial attention on the Netherlands-US Open Skies agreement. However, we also examine the growth in air traffic between the Netherlands and other countries with liberalised bilateral agreements, such as Kenya, Malaysia, and Brazil.

We have largely focused on the impacts of aviation liberalisation on traffic volumes between Schiphol and the various countries. Liberalisation should lead, among other things, to lower fares, a greater frequency of flights, and better service. All of these should result in increases in traffic volumes. The proliferation of fares and fare classes makes analysing the impact of liberalisation on prices more problematic and difficult. In addition, valuing greater flight frequency and better service also presents problems. Increases in traffic volume are easier to measure and are a more consistent metric across the various markets we examine, and thus form the basis of our analysis. However, we also provide estimates of the impact of liberalisation on employment in the airline sector, consumer welfare, and output increases in industries that supply the air transportation industry.

To analyse the economic impact of the Netherlands-US Open Skies agreement, we rely on passenger count and itinerary data.[2] Statistical techniques are used to identify the relationship between passenger volumes and market demand and cost factors based on the market experience prior to liberalisation. The results from this analysis are then used to predict the passenger volumes that would have arisen if liberalisation had not occurred, assuming that the demand and cost conditions were identical to those observed after liberalisation. The predicted traffic volumes in the absence of liberalisation are then compared with the actual traffic volumes under liberalisation to measure the impact of the Open Skies agreement.

The above analysis of passenger and freight volumes leads to an assessment of the gains to consumers that have been spawned by liberalisation through the Open Skies agreement. Using our estimates of the direct increase in traffic volumes and spending on air transportation that resulted from Open Skies, we then calculate the direct spin off of this agreement in terms of increased Dutch employment and increased output in aviation-related businesses.

Besides formal statistical analyses of passenger volumes, we also present "before-after" and "cross-sectional" comparisons of market performance to assess how Schiphol's development as a hub airport may have been affected by liberalisation. This assessment focuses on the growth of transfer passengers at Schiphol, changes in the number of cities reached directly from Schiphol, and changes in competitive conditions.

We use many of the same techniques to analyse the economic impact of aviation liberalisation with Kenya, Malaysia, and Brazil. For example, we use passenger count

[2] Passenger Counts data by route (*i.e.*, onboard origin-and-destination data) and Survey data on passenger itineraries were provided by the Netherlands Directorate General for Civil Aviation. Passenger counts by transatlantic flight segment were obtained from the US Department of Transportation's T-100 International Databank.

data and regression techniques to examine the increase in passenger volumes associated with liberalisation. The statistical approach differs slightly from that used for the Netherlands-US analysis. Rather than predicting passenger volumes based on the statistical relationship between the volume of passengers and cost and demand conditions that was observed prior to liberalisation, and comparing those predicted volumes with actual passenger traffic after liberalisation, we instead add "indicator" variables to our regression specification. These variables identify volume impacts arising in the period of liberalisation that cannot be explained by changes in cost and demand conditions affecting the aviation market.

Methodology for Measuring the Extent of "First-Mover" Advantages in Aviation Liberalisation

The economic literature devotes substantial attention to first-mover advantages and disadvantages in explaining the competitive position of firms in the marketplace. Many of the same arguments apply here when considering how the "competitive position" of Schiphol airport might have been affected by the Netherlands' "first move" in establishing an Open Skies agreement with the United States before other European countries. The economic literature suggests that first-mover advantages may be quite important in industries with substantial network economies, where the size of the network and the number of network users may constitute a competitive advantage. Thus, first-mover advantages may exist in aviation if an airline or airport expands its network of operations and its flight frequency prior to its competitors.

To assess the extent that a first-mover advantage exists for airlines or airports, we compare the performance of the Netherlands relative to Belgium and Germany under their Open Skies agreements with the United States. By establishing its Open Skies agreement first, we seek to analyse whether passenger traffic between the Netherlands and the United States was stimulated relative to passenger traffic between Belgium or Germany and the United States over the same period.

Our analysis of first-mover effects also examines how the behaviour of passenger volumes through Schiphol has compared in the Open Skies period to that of other major European hub cities. These cities include Brussels, Frankfurt, London, and Paris.

Aviation Liberalisation as International Trade Liberalisation: Expected Economic Impact

As described in Section 3, analysis of the economic effects of liberalisation of international aviation begins from the perspective of the theory of international trade and investment. This is one of the best understood and least controversial (among economists) areas of economics.

Both theoretical models and empirical results indicate that trade liberalisation produces greater efficiency, increased output, and improved social welfare that potentially accrues to both trading partners. These benefits arise from a number of different sources, including the following:

- More efficient firms replace less efficient firms (and/or less efficient firms become more efficient).
- Scale, scope, and density economies are exploited over a larger market.
- Closer integration among firms leads to lower costs and prices.
- Output expands as a result of cost and price reductions or the removal of explicit output restrictions.
- Capital moves into markets offering relatively high returns.

If one views aviation liberalisation as a form of international trade liberalisation, where the "traded" good is air transportation services, then economic theory predicts that liberalisation will result in increased passenger volumes and lower airfares to consumers. This outcome occurs because liberalisation reduces impediments to aviation competition and removes explicit limitations on flight frequencies and route offerings. As a result costs decline, prices decrease, and output expands.

The Economic Effects of the Netherlands-US Open Skies Agreement

Section 4 contains the results of our empirical analysis of the impact of the Netherlands' Open Skies agreement with the United States. Based on economic theory, one would expect that a liberalised air transport policy would lead to increased passenger (and freight) volumes between the Netherlands and the United States. With the Open Skies agreement allowing more potential carriers to offer transatlantic flights through more potential gateways, increased competition should result in lower fares and increased passenger volumes.

Although other European countries completed aviation liberalisation (*i.e.*, Open Skies) agreements with the United States subsequent to the Netherlands-US Open Skies agreement, the annual growth rate of US-Netherlands passenger traffic during the Open Skies period (*i.e.*, 1992-2000) was still more than double that of the pre-Open Skies period (*i.e.*, 1985-1991). The growth of US-Netherlands freight volumes, however, was slightly lower in the Open Skies period relative to the pre-Open Skies period, though the decrease occurred primarily after other European countries liberalised their aviation policies.

With respect to the impact of aviation liberalisation on the transatlantic route network served by Schiphol, the growth rate of transatlantic passenger routes and freight routes both declined under Open Skies. Similar to the behaviour of freight volumes, the growth rates of new routes diminished after other European countries liberalised their aviation policies.

Despite the above results concerning the apparent lack of expansion of the transatlantic route network, we find that the Open Skies agreement between the Netherlands and the United States was associated with a boom in connecting passengers travelling between Schiphol and the United States. This includes substantial increases in passengers that originated or terminated in the United States at airports that were not transatlantic gateways. It also includes sharp increases in passengers that originated or terminated in other European countries and travelled through Schiphol on their way to or from the United States. Overall, our simple comparisons suggest that the Netherlands-US Open Skies agreement may have had a profound influence on Schiphol's development as a hub airport.

The Open Skies agreement between the Netherlands and the United States also led to an increase in the number of carriers on routes between the two countries. Based purely on the number of competitors, it appears from this analysis that Open Skies led to greater carrier competition on Netherlands-US routes. In addition, we show that new carriers entered certain routes after completion of the Open Skies agreement. However, without data on the fares that these carriers are charging and the costs they incur, one cannot assess whether price-cost margins have been affected by this apparent increase in competition. Furthermore, our analysis does not attempt to assess whether the competitive interaction among firms has changed significantly under liberalisation.

Finally, we used statistical methods, namely regression techniques, to separate the impact on passenger traffic of aviation liberalisation from effects that are attributable to changes in market demand and cost conditions. Based on this analysis, we find that the Netherlands-US Open Skies agreement was associated with a 51 percent increase in passenger volumes between the Netherlands and the United States (on average from the fourth quarter of 1992 through 2000).

Liberalisation between Netherlands and Other Countries

Section 5 assesses the economic impact of Netherlands aviation liberalisation with Kenya, Malaysia, and Brazil. The evidence suggests that both passenger and freight volumes between the Netherlands and Kenya increased significantly subsequent to a liberalisation agreement in 1997. Regression techniques indicate that the 1997 agreement was associated with a 157 percent increase in passenger volumes between the Netherlands and Kenya. Simple comparisons suggest that this increase is not the result of diverting passengers that previously had travelled from or to other African destinations; however, there was a dramatic increase in the number of passengers transferring through Nairobi after the 1997 liberalisation occurred.

The evidence also suggests both passenger and freight volumes between the Netherlands and Malaysia increased under liberalisation, particularly after the latest liberalisation in September 1995. Our regression analysis suggests that the 1992 liberalisation between the Netherlands and Malaysia was associated with an almost 20 percent increase in traffic between the two countries, while the 1995 agreement was associated with a further 36.4 percent increase in passenger traffic. The combined effect of both agreements was a 63 percent increase in traffic. Again, we find evidence that the

number of transferring passengers through Kuala Lumpur increased after both agreements, though the largest increase occurred after the 1995 agreement.

Our analysis did not find that liberalisation with Brazil was associated with increased passenger traffic. We believe that this result may be related to the difficulties involved in finding variables for our statistical analysis that accurately reflect Brazil's political and economic situation over the past decade.

With respect to the growth of freight volumes, Brazil fared a little worse than the rest of Latin America after the 1989 liberalisation, but much better after the 1994 agreement (at least until 1998). Overall, between 1990 and 1998, Brazil experienced growth in its freight volumes with the Netherlands that substantially exceeded the growth rate of freight volumes between the Netherlands and the rest of Latin America.

Dutch First-Mover Advantage

Section 6 considers whether the Netherlands has achieved an advantage by establishing an Open Skies agreement with the United States before other European countries entered into similar agreements. Our results show that passenger traffic through Schiphol to the United States exhibits patterns associated with a "first-mover" advantage.

Passenger volumes through Schiphol grew at a faster rate over the Open Skies period (1992-2000) than passenger volumes through other European hubs. Moreover, regression analysis indicates that, after controlling for changes in market cost and demand conditions, the Netherlands experienced much higher increases in transatlantic passenger volumes under its Open Skies agreement with the United States than Belgium and Germany did under their Open Skies agreements.

Looking over the entire period from the completion of the Netherlands-US Open Skies agreement (in September 1992) through the end of 2000, we find that the Netherlands-US Open Skies agreement was associated with substantially higher transatlantic passenger volumes between the two signatory countries than the Belgium-US or Germany-US Open Skies agreements. This relationship continued to hold in recent years. For instance, in the last year of our data set (*i.e.*, 2000), our analysis finds that its Open Skies agreement with the United States was associated with a 70.1 percent increase in transatlantic passenger volumes for the Netherlands, 5.0 percent increase in transatlantic passenger volumes for Belgium, and a 1.2 percent decrease in transatlantic passenger volumes for Germany.

Economic Impacts

We estimated the increase in employment and the additional benefits to consumers (*i.e.*, consumer surplus) that were associated with the Open Skies agreement between the Netherlands and the United States. In addition, our analysis examined the impact of the Open Skies agreement on industries that produce inputs into air transportation between the Netherlands and the United States.

We estimated that the Open Skies agreement was associated with an increase in airline and airport employment in the Netherlands of approximately 2,500 employees in

2000. These estimates suggest that the Open Skies agreement resulted in only modest employment increases in the aviation sector in the Netherlands, though data limitations preclude us from considering certain factors that may increase or decrease the employment impact.

Consumer benefits from the Open Skies agreement were estimated to range from €0.5 billion to €1.4 billion annually by 2000. These benefits accrued to passengers in the Netherlands and the United States (and those from elsewhere who flew through Schiphol). Approximately 17 percent of the travellers from Schiphol to the United States in 2000 were Dutch nationals, implying that approximately €85 million to €245 million in annual consumer benefits were realised by Dutch travellers. These estimates should be viewed with some caution, however. Our consumer surplus analysis may not fully reflect the value of increased consumer choice associated with the Open Skies agreement, where increased choice occurs in the form of more frequent flights, additional city-pair routes, and a greater variety of air carriers.

Lastly, we estimated that the Netherlands-US Open Skies agreement was associated with approximately €1.15 billion per year in increased passenger demand for air transportation. This translates into a €1.15 billion "direct" output increase in industries that supply air transportation and in payments to labour and capital used in air transportation. However, the increased output of firms supplying the air transportation industry will stimulate increased output in other sectors as well, which constitutes an "indirect" source of increased output. After all economic interactions are considered—both direct and indirect—the increased passenger demand for air transportation under Open Skies has generated output increases of €2.12 billion per year across all industries.

However, not all airlines providing service between the Netherlands and the United States, nor the firms that supply those airlines, are located within the Netherlands. For this reason, any estimates of the increased output in the Netherlands arising from Open Skies must be significantly lower than the above figures.[3]

[3] Data limitations have prevented us from further refining all of the economic impacts (consumer surplus, employment, and output impacts) and narrowing the focus to just the Dutch economy.

1. Introduction

The Netherlands Directorate General of Civil Aviation has asked *The Brattle Group* to assist them in evaluating the effectiveness of Dutch air transport policy. In particular, the Directorate General seeks research that analyses the following questions:

1. What has been the economic impact, in terms of accessibility by air and economic spin off, of the Dutch liberal air transport policy up till now?

2. Has the forefront position in Open Skies relations been advantageous in the end? Did the forefront position have any negative effects and/or were the positive effects by far more important?

Using aviation industry data and economic reasoning, this study offers analyses useful in answering the above questions.

The rest of the study is organised as follows. Section 2 describes our methodological approach. Since international aviation liberalisation is equivalent to a form of international trade liberalisation, Section 3 briefly discusses the likely economic impacts of liberalisation from the perspective of the economic literature on international trade. Section 4 assesses the economic effects of Dutch aviation liberalisation policy, focusing particularly on the Open Skies agreement between the Netherlands and the United States. In Section 5, we assess the effects of Dutch liberalisation with Kenya, Malaysia, and Brazil. Section 6 analyses whether the Netherlands' forefront position in liberalisation was advantageous, particularly its completion of an Open Skies agreement with the United States in advance of other European countries. Section 7 quantifies the economic spin off impacts from Dutch air transport policy. Section 8 offers concluding commentary.

2. Methodology and Content

We will discuss our methodology for answering each policy question posed by the Directorate General for Civil Aviation. Our results are described in detail in Sections 4 through 7 below.

Question 1: What has been the economic impact, in terms of accessibility by air and economic spin off, of the Dutch liberal air transport policy up till now?

The above question seeks to find out whether consumers, airlines, input suppliers, and workers have gained substantially from Dutch aviation liberalisation with the United States and other countries.

Past Findings

Past research suggests that the Netherlands' liberal air transport policy has been effective, specifically the pioneering 1992 Open Skies agreement between the Netherlands and the United States. That agreement made it possible for KLM and Northwest Airlines to obtain antitrust immunity for their alliance—the first alliance to gain such protection.

As described below, several studies have relied on descriptive measures to conclude that the Open Skies agreement and the KLM-Northwest alliance have been very successful:

- A 1995 report by the US General Accounting Office indicated that in 1994, KLM had increased its traffic by 150,000 passengers as a result of its alliance with Northwest, while its revenue had increased about $100 million.[4]

- In a 1996 paper, Martin Staniland, an expert on European aviation, wrote that "for Amsterdam, the [KLM-Northwest] alliance has been a dramatic success." According to Staniland, the number of transatlantic passengers flying through Schiphol increased by 74 percent over a five-year period, reaching 2,400,000 in 1994.[5]

- In a 1999 report on global deregulation, the US Department of Transportation (DOT) documented the continued strong growth in US-Netherlands traffic. Comparing data from 1992 and 1998, DOT found that passenger traffic moving between US gateway cities and Amsterdam under the KLM-Northwest alliance had more than doubled. DOT also found that new traffic flows from the United

[4] US General Accounting Office, Resources, Community, and Economic Development Division, *International Aviation: Airline Alliances Produce Benefits, but Effect on Competition is Uncertain*, GAO/RCED-95-99 (Washington, D.C.: April 1995), 27-28.

[5] Martin Staniland, "Open Skies—Fewer Planes? Public Policy and Corporate Strategy in EU-US Aviation Relations," *European Policy Paper Series*, No. 3 (Center for West European Studies, University of Pittsburgh: August 1996).

States had helped KLM expand its Amsterdam hub service to more distant points in Africa, the Middle East, and the Far East.[6]

- In a subsequent report, DOT expanded its analysis of the KLM-Northwest alliance, as well as two other alliances that received antitrust immunity in 1996. DOT concluded that the growth in traffic was predominantly among passengers in the connecting markets rather than the gateway markets themselves. The largest increases in traffic—and the sharpest drop in fares—had occurred in Europe's connecting markets, which had been poorly served prior to the advent of alliances.[7]

Methodology for Measuring the Economic Effects of Liberalisation

Despite the findings of the above studies, an analysis of the economic impact of Dutch aviation policy requires a more formal methodology. This report examines the impact of Dutch aviation policy by comparing market performance data before and after liberalisation. In addition, we use statistical methods to distinguish the economic effects of changes in aviation policy from the impact of changes in market supply and demand conditions.

We focus substantial attention on the Netherlands-US Open Skies agreement. However, we also examine the growth in air traffic between the Netherlands and other countries with liberalised bilateral agreements, such as Kenya, Malaysia, and Brazil.

Predicting the Impact of Liberalisation

To analyse the economic impact of the Netherlands-US Open Skies agreement, we rely on passenger count and itinerary data.[8] Statistical techniques are used to identify the relationship between passenger volumes and market demand and cost factors based on the market experience prior to liberalisation. The results from this analysis are then used to predict the passenger volumes that would have arisen if liberalisation had not occurred, assuming that the demand and cost conditions were identical to those observed after liberalisation. The predicted traffic volumes in the absence of liberalisation are then compared with the actual traffic volumes under liberalisation to measure the impact of the Open Skies agreement.

The above analysis of passenger volumes leads to an assessment of the gains to consumers that have been spawned by liberalisation through the Open Skies agreement. Using our estimates of the direct increase in traffic volumes and spending on air

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[6] US Department of Transportation, Office of the Secretary, *International Aviation Developments: Global Deregulation Takes Off (First Report)* (Washington, D.C.: December 1999), 7, 13.

[7] US Department of Transportation, Office of the Secretary, *International Aviation Developments (Second Report): Transatlantic Deregulation—The Alliance Network Effect* (Washington, D.C.: October 2000).

[8] Passenger Counts data by route (*i.e.*, onboard origin-and-destination data) and Survey data on passenger itineraries were provided by the Netherlands Directorate General for Civil Aviation. Passenger counts by transatlantic flight segment were obtained from the US Department of Transportation's T-100 International Databank.

transportation that resulted from Open Skies, we then calculate the direct economic spin off of this agreement in terms of increased Dutch employment and added value to aviation-related businesses in the Netherlands.

Past economic analyses of the effects of lifting regulatory barriers have frequently relied on cross-sectional comparisons of market performance, where the analysis measures the economic impact of liberalisation (or deregulation) by comparing how less-restricted markets perform relative to more-restricted markets over the same time period. These comparisons can be made informally or with more formal statistical methods, such as regression techniques that account for certain cost and demand differences across markets. However, from the standpoint of industrial economics, it is often a better approach to examine how the performance of a specific market changes after restrictions governing that market are lifted or liberalised. This approach avoids having to account for the potentially numerous demand and supply factors that cause markets to behave differently.

Our analysis combines a "before-after" event-study approach with "cross-sectional" (*i.e.*, "side by side") assessments. For example, we use simple comparisons and formal regression methods to analyse how passenger volumes between the Netherlands and the United States changed after the Open Skies agreement. This is essentially a "before-after" event-study approach. At the same time, we also compare how the Netherlands fared under Open Skies with the United States relative to Belgium, Germany, and other European countries. In that sense, part of our analysis is necessarily "cross-sectional" in nature.

We employ a similar approach in analysing the impact of aviation liberalisation between the Netherlands and Kenya, Malaysia, and Brazil. For example, we compare how passenger and freight volumes changed when the aviation agreement was liberalised between the Netherlands and Kenya. We compare how traffic volumes between the Netherlands and Kenya changed relative to volumes between the Netherlands and other African countries. Formal statistical methods are then used to isolate the change in passenger volume associated with liberalisation from that attributable to changes in supply and demand conditions. A similar approach is used in assessing liberalisation with Malaysia and Brazil.

Simple Comparisons Offer Additional Insights

Besides formal statistical analyses of passenger volumes, we also present "before-after" and "cross-sectional" comparisons of market performance to assess how Schiphol's development as a hub airport may have been affected by liberalisation. This assessment focuses on the growth of transfer passengers at Schiphol, changes in the number of cities reached directly from Schiphol, and changes in the number of airlines competing on city-pair routes.

Data Sources

We utilise several data sources in formulating our results. These sources include Schiphol Counts data, which counts the number of scheduled passengers onboard

airplanes travelling between Schiphol and designated locations. In addition to these data, the Netherlands Directorate General of Civil Aviation provided Schiphol Survey data that contains information on the actual origin and destination points of a sample of passengers travelling from or transferring at Schiphol airport.[9]

We also relied on passenger count data by flight segment provided by the US Department of Transportation's T-100 International Databank. In contrast to the Schiphol Counts data which identifies passenger volumes based on the foreign origin or destination of the passengers on direct flights between Schiphol and the United States, the T-100 data identifies transatlantic passenger volumes based on their European and US gateways. Hence, a passenger travelling on a single flight from Schiphol to Minneapolis with a stop in Detroit is categorised as a Schiphol-Minneapolis passenger by the Schiphol Counts data. In the T-100 flight segment data, this passenger is categorised as a Schiphol-Detroit passenger.

To allow for changes in cost and demand factors that may influence passenger volumes on particular routes, we collected information on gross domestic product (GDP), exchange rates, and producer prices for the Netherlands and other countries of interest. These macroeconomic variables came from various sources, including Eurostat, the Air Transport Association of America, the US Federal Reserve Bank of St. Louis, the US Department of Commerce, the IMF, and Statistics Netherlands.[10]

Question 2: Has the forefront position in Open Skies relations been advantageous in the end? Did the forefront position have any negative effects or were the positive effects by far more important?

The above question seeks to find out whether it has been advantageous for the Netherlands to have been a "first mover" in establishing Open Skies relations with the United States and liberalising with other countries. The Open Skies agreement between the Netherlands and the United States became effective in September 1992, well before similar agreements went into effect between the United States and Belgium (May 1995), Denmark (May 1995), and Germany (February 1996).

Economic Arguments for First-Mover Advantages

The economic literature devotes considerable attention to "first-mover" advantages and disadvantages in explaining the competitive position of firms in the marketplace. Many of the same arguments apply here when considering how the "competitive position" of Schiphol airport might have been affected by the Netherlands' "first move" in establishing an Open Skies agreement with the United States before other European countries.

The economic literature suggests that first-mover advantages may be quite important in industries with substantial network economies. In aviation, the presence of scale and

[9] These passengers are referred to in the report as negative or positive transfer passengers.

[10] See Table 16 in Appendix I for more detailed information on these various data sources.

network economies leads to lower costs for airlines as their size and reach increases.[11] In addition, the hub-and-spoke system creates increased convenience as a hub airport is connected to a greater number of cities and as flight frequency into and out of the hub increases due to increased passenger volumes. These effects imply that, if an airline constructs a large network before its rivals, demand may increase for that airline's services and that airline may face lower costs in adding more routes. Thus, as an industry with network economies, substantial first-mover advantages may exist in aviation if an airline (or airport) expands its operations and network size prior to its competitors.

Based on the above argument, an airline theoretically can create a first-mover advantage by establishing a large hub-and-spoke network that provides low-cost transportation to a variety of locations through its central hub. It follows that if network economies and first-mover advantages accrue to a given airline when it successfully builds a large hub-and-spoke network before its competitors, some of the same competitive advantages accrue to the hub airport relative to other airports that may compete for air transportation services. An airport that originates and receives flights from many destinations would be an attractive airport to receive passengers from additional origin points (or to fly passengers to other destination points). As the flight frequency at the airport increases, it also may increase the attractiveness to airlines of scheduling an additional flight into the airport (since connections are facilitated).

To illustrate the above reasoning, assume that an airline's hub airport is connected to ten other cities. If that airline or any other airline begins service that connects another city to the hub airport, then eleven additional city-pairs can be reached through the airport (where eleven represents connections from the new city to the hub airport and the ten other cities). However, if twenty cities are connected to the hub airport, then the addition of one more city that connects to the hub airport results in twenty-one additional city-pair combinations that can be reached through the hub airport. Thus, the attractiveness to airlines of offering service from another city to the hub airport may increase as the network of destinations that can be reached from the hub airport increases.

This represents a network economy (or economy of scope) that arises in transportation and other network industries. It also represents a potential first-mover advantage for an airport that establishes an extensive network of flights, or frequent flights to other cities, prior to other airports.

Methodology for Measuring the Extent of "First-Mover" Advantages in Aviation Liberalisation

To assess the extent to which a first-mover advantage may exist for airlines or airports, we compare the performance of the Netherlands relative to Belgium and Germany under their Open Skies agreements with the United States. By establishing its Open Skies agreement first, we seek to analyse whether passenger traffic between the

[11] *Economies of scale* arise when a firm's average cost decreases as its volume of output increases. *Economies of scope (or network economies)* arise when a firm's average cost decreases as new products or services are added.

Netherlands and the United States was stimulated relative to passenger traffic between Belgium or Germany and the United States over the same period.

We have chosen Belgium and Germany as comparisons with the Netherlands for two reasons. First, Belgium is a country of approximately the same size that borders the Netherlands. Given the similarity between the two countries, we would expect that if there were no first-mover advantage, then Belgium would experience the same benefits through the Open Skies liberalisation process as the Netherlands. If Belgium did not experience the same stimulus in air traffic with the United States, this lends credence to the argument that the Netherlands benefited from liberalising first.

Second, we have chosen Germany because it was the first of the large European countries to liberalise after the Netherlands, and it also borders the Netherlands. France and Italy signed Open Skies agreements with the United States at least two years later than Germany.[12] Thus, if Germany, as a much larger nation with a large national carrier, experienced smaller benefits from liberalisation than the Netherlands, this also would support the contention that the Netherlands gained a unique advantage from liberalising transatlantic travel with the United States before other European countries.

We analyse changes in the behaviour of transatlantic passenger volumes between the United States and the Netherlands, Germany, and Belgium during three periods:

- the period between the Netherlands-US Open Skies agreement and the Belgium-US Open Skies agreement
- the period between the Belgium-US Open Skies agreement and the Germany-US Open Skies agreement
- the period after the Germany-US Open Skies agreement

From the above analysis, we can assess how the volume of transatlantic passengers using Schiphol airport was affected by Dutch aviation liberalisation with the United States. Then, we can estimate how passenger volumes through Schiphol were affected after Belgium and Germany liberalised their aviation agreements with the United States. By performing a similar analysis on the passenger volumes between Belgium and Germany and the United States, we are then able to make a side-by-side comparison of which country benefited the most from the entire Open Skies liberalisation process. In turn, this comparison allows us to determine the extent of any advantage gained by the Netherlands from concluding its Open Skies agreement with the United States prior to other European countries.

Our analysis of first-mover effects also examines how the behaviour of passenger volumes through Schiphol has compared in the Open Skies period to that of other major European hub cities. These cities include Brussels, Frankfurt, London, and Paris.

[12] France signed a major air liberalisation with the United States in April 1998, and signed its Open Skies agreement in October 2001. Italy signed its Open Skies agreement with the United States in November 1998.

3. Aviation Liberalisation as International Trade Liberalisation: Expected Economic Impact

Analysis of the economic effects of liberalisation of international aviation agreements begins from the perspective of the theory of international trade and investment, one of the best understood and least controversial (among economists) areas of economics. Both theoretical models and empirical results indicate that trade liberalisation produces greater efficiency, increased output, and improved social welfare that potentially accrues to both trading partners. These benefits arise from a number of different sources, including the following:

- More efficient firms replace less efficient firms (and/or less efficient firms become more efficient).
- Scale, scope, and density economies are exploited over a larger market.
- Closer integration among firms leads to lower costs and prices.
- Output expands as a result of cost and price reductions or the removal of explicit output restrictions.
- Capital moves into markets offering relatively high returns.

If one views aviation liberalisation as a form of international trade liberalisation, where the "traded" good is air transportation services, then economic theory predicts that liberalisation will result in increased passenger volumes and lower airfares to consumers. This outcome occurs because liberalisation reduces impediments to aviation competition and removes explicit limitations on flight frequencies and route offerings. As a result costs and prices decrease and output expands.

4. The Economic Effects of the Netherlands-US Open Skies Agreement

This section contains the results of the empirical analysis of the impact of the Netherlands' Open Skies agreement with the United States. As described above, the Netherlands was the first European country to sign an Open Skies agreement with the Unites States. Other countries that followed include Belgium (in 1995), Germany (in 1996), Italy (in 1998) and France (in 2001, although there was also a major air liberalisation between France and the United States in April 1998). The impact of the Netherlands' Open Skies agreement with the United States can be viewed on its own, and in relation to these other countries that liberalised later.

As stated above, one would predict based on economic theory that a liberalised air transport policy would lead to increased passenger (and freight) volumes between the Netherlands and the United States. The Open Skies agreement with the United States effectively allowed any US or Dutch national carrier to fly between any two airports in the two countries capable of handling transatlantic traffic. Previously, the aviation agreements between the United States and the Netherlands restricted the output or features of transatlantic service, such as the eligible carriers, number of flights, or the eligible US gateways.

With more potential carriers offering transatlantic flights through more potential gateways after the Netherlands-US Open Skies agreement, one would expect to observe increased competition, lower fares, and increased passenger volumes. We test this hypothesis by examining what happened to passenger (and freight) volumes and city-pair service between the United States and the Netherlands before and after September 1992, when the Open Skies agreement was signed.

We use a two-step process to assess the impact of the Open Skies agreement. First, simple comparisons examine trends in passenger and freight volumes and city-pair service between Schiphol and the United States. Second, statistical methods, namely regression techniques, are used to separate the impact of aviation liberalisation (*i.e.*, the Netherlands-US Open Skies agreement) on passenger volumes from the effects attributable to changes in demand and cost conditions over time.

4.A Simple Comparisons

Passenger Volumes and Routes

Using the Schiphol Counts data set, we calculated the number of arriving and departing scheduled passengers between Schiphol and US gateway cities.[13] As can be seen from Table 1, the annual growth rate of traffic between 1985 and 1991 was 6.3 percent, while the annual growth rate from 1992 to 2000 was 13.0 percent. Based on this

[13] For this section and the following regarding freight, we have excluded routes that did not account for one percent of the total traffic in a given year.

simple comparison, the Open Skies agreement with the United States appears to have led to increased passenger traffic between Schiphol and the United States.

Table 1

Intercontinental Passenger Traffic between Schiphol and the United States (1985 - 2000)

Measure	*Year*																*Annual Growth Rates*	
	1985	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*1985 - 1991*	*1992 - 2000*
Passengers	1,024	1,023	1,108	1,127	1,248	1,363	1,475	1,735	2,066	2,450	2,796	3,268	3,716	4,067	4,510	4,624	6.3%	13.0%
Routes	5	5	5	6	8	8	9	10	12	13	15	14	14	16	16	15	10.3%	5.2%

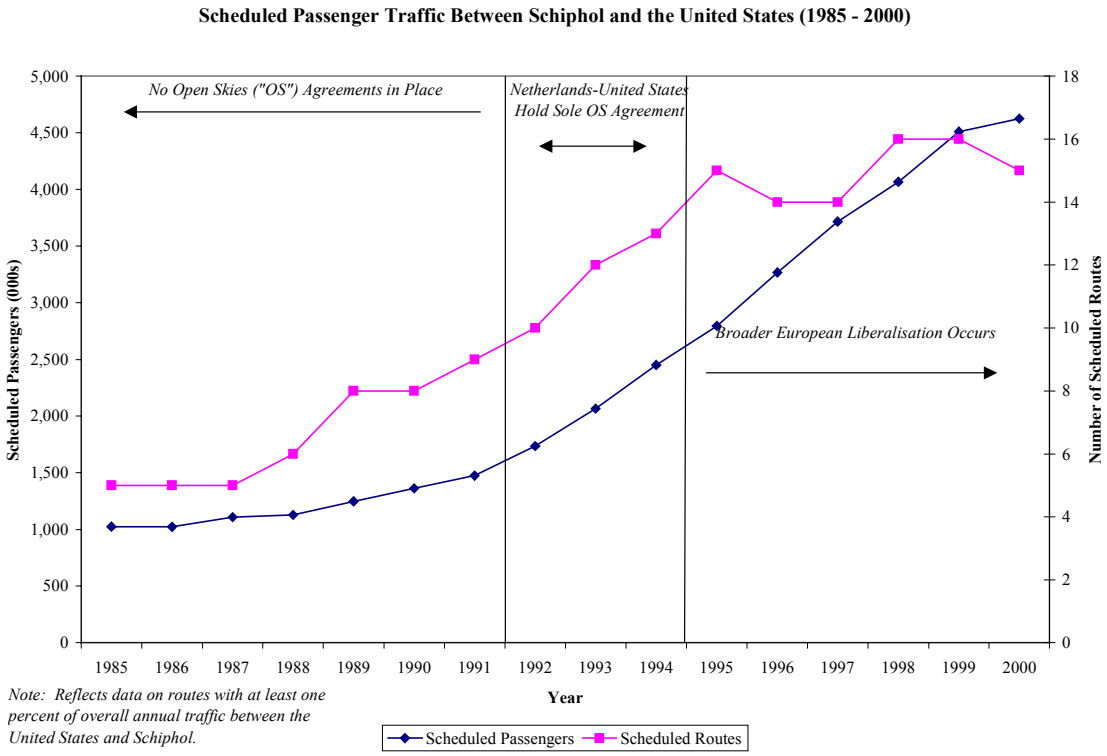
Source: Schiphol Counts data.
Reflects volumes for routes which represent at least one percent of total annual traffic between Schiphol and the United States.
Passenger defined as thousands of arriving and departing scheduled passengers.
Routes defined as all unique gateway airports transporting scheduled passengers to or from Schiphol.

We also examined the number of city-pair routes between Schiphol and the United States and present these in Table 1. Using the same Schiphol Counts data, we found that the annual growth rate of the number of city-pair routes between Schiphol and the United States went from 10.3 percent between 1985 and 1991 to 5.2 percent between 1992 and 2000. While the decline in rates seems to indicate that Schiphol was not more heavily utilised after the Open Skies agreement, a different story emerges upon closer examination.

Figure 1 shows the annual levels of both passenger traffic and the number of routes between Schiphol and the United States. The left axis indicates the number of passengers, while the right axis indicates the number of routes being served. As can be seen clearly from the graph, the advent of Open Skies in 1992 led to a dramatic increase in both passenger volumes and the number of routes being served between the United States and Schiphol. In fact, the number of city-pairs served directly between Schiphol and the United States increased by more than 50 percent between 1991 and 1995. However, once nearby EU countries liberalised their own aviation agreements with the United States beginning in 1995,[14] the number of routes between Schiphol and the United States stayed the same. Consequently, the annual growth rate is slightly less in the 1992-2000 period when compared to the 1985-1991 period.

[14] Austria, Belgium, Denmark, Finland, Iceland, Luxembourg, Norway, and Sweden all signed Open Skies agreements with the United States in May 1995, while Germany signed an Open Skies agreement with the United States in February 1996.

Figure 1



If we split the post-1992 period into two periods, the annual growth rate in the number of routes from 1992 to 1995 was 14.5 percent, while there was no overall change in the number of routes from 1995 to 2000. Part of the reason the number of routes between the United States and Schiphol stayed relatively constant after 1995 was likely due to competition from other European Open Skies countries. As mentioned previously, the Belgium-US Open Skies agreement became effective in May 1995, while the Germany-US Open Skies agreement became effective in February 1996.[15]

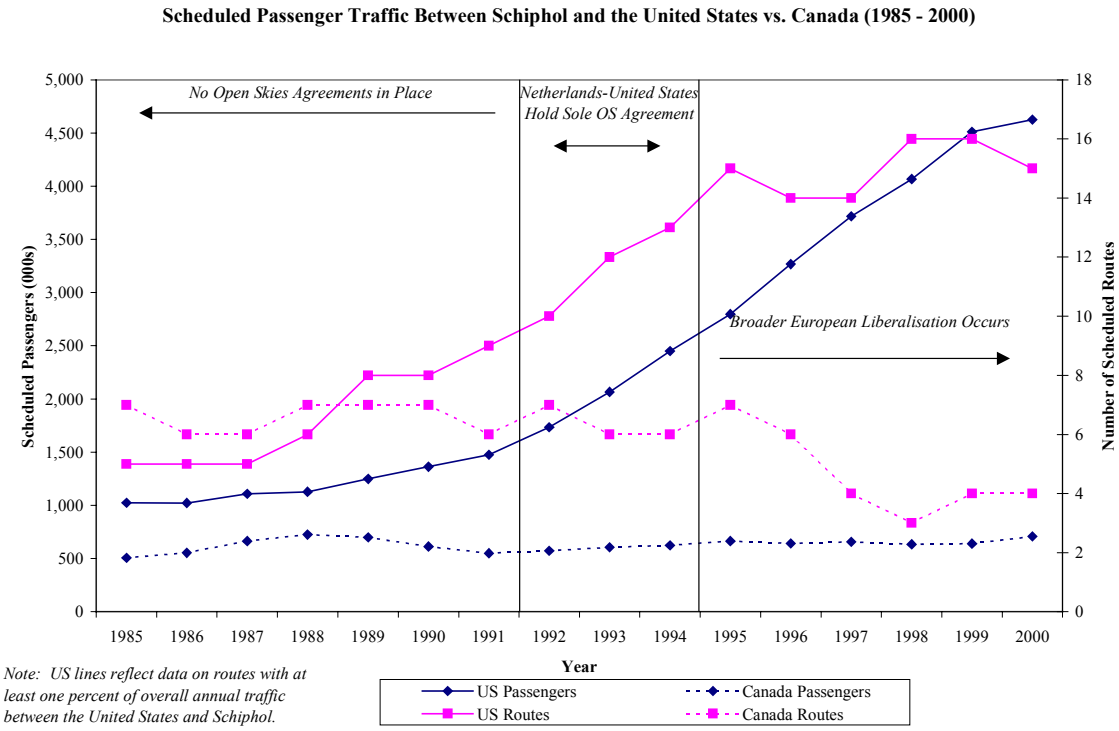
We also calculated the rate of growth of passenger volumes between Schiphol and the United States in the 1992-1995 period and the 1995-2000 periods. From 1992 to 1995, passenger volumes between Schiphol and the United States grew at 17.2 percent, while from 1995 to 2000 the rate of growth was only 10.6 percent.

To further examine whether the Open Skies agreement was the source of substantive increases in passenger traffic between the Netherlands and the United States, we compared changes in passenger volumes and the number of routes between the Netherlands and the United States with those between the Netherlands and Canada. Since the aviation agreement between the Netherlands and Canada is substantially more restrictive than the Open Skies agreement with the United States, it would be difficult to

[15] Another possible reason for the slowdown in growth of routes could have been a completion of network rationalisation by KLM and Northwest after their alliance was formed. The two airlines may have concentrated transatlantic traffic at certain hubs by 1995 and may not have needed to expand into other transatlantic routes. In addition, the alliance could have taken away traffic from other competitors (*e.g.*, fifth freedom traffic from Asian airlines) that might have created additional routes between Schiphol and the United States.

attribute increased passenger volumes between the Netherlands and the United States to the impact of Open Skies alone if similar passenger growth was experienced between the Netherlands and Canada. As can be seen in Figure 2, the results for Canada are in marked contrast to those of the United States. Passenger volumes between the Netherlands and Canada stayed relatively flat after 1992, and the number of Netherlands-Canada routes declined from seven in 1992 to four in 2000.[16]

Figure 2



Freight Volumes and Routes

The pattern of freight traffic over time between Schiphol and the United States is even more striking. Table 2 is analogous to Table 1, except here we show freight movements rather than passenger movements. The annual growth rates of freight volume and routes after the Netherlands-US Open Skies agreement were both lower after 1992 than they were prior to 1992. Freight grew at an annual rate of 4.6 percent before 1992 and at a rate of 4.1 percent afterwards. The number of routes carrying freight between Schiphol and the United States grew at an annual rate of 12.2 percent prior to 1992 and at a rate of 3.1 percent afterwards. However, these simple statistics hide an interesting underlying pattern.

[16] It is likely that the decrease in the number of routes was due, at least in part, to the Open Skies agreement. The number of negative transfer passengers from Schiphol to the United States who transferred to Canada increased after the 1992 Netherlands-US Open Skies agreement was signed.

Table 2

Intercontinental Scheduled Freight Traffic between Schiphol and the United States (1985 - 2000)

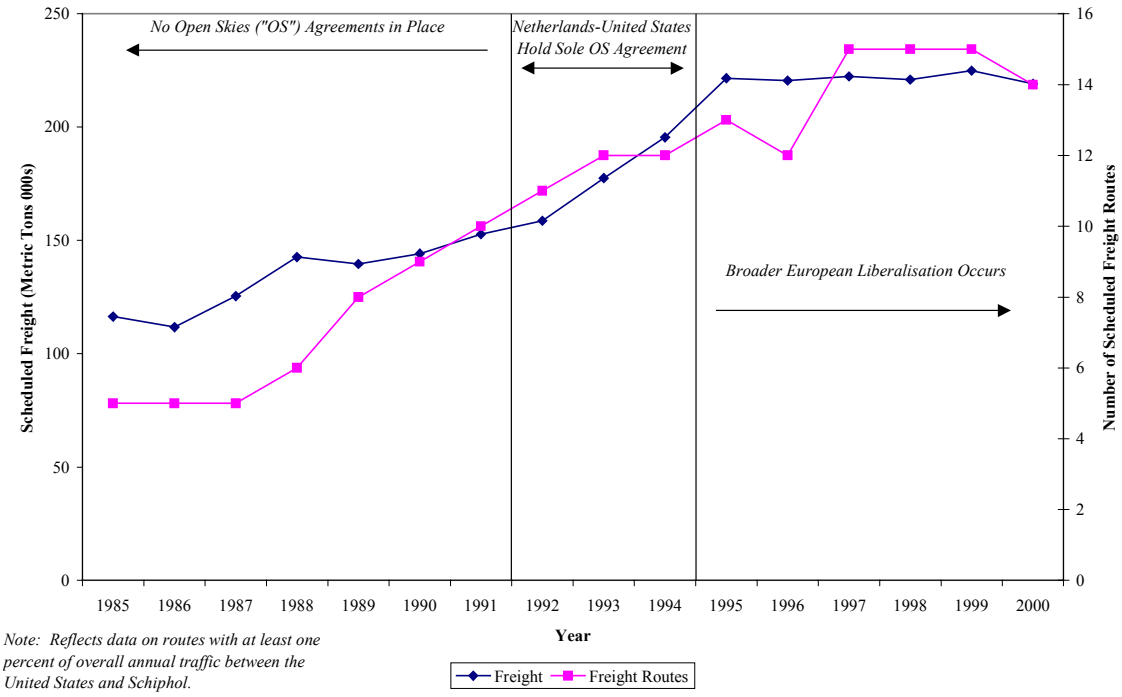
Measure	*Year*																*Annual Growth Rates*	
	1985	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*1985 - 1991*	*1992 - 2000*
Freight	116	112	125	143	140	144	153	159	178	195	222	220	222	221	225	219	4.6%	4.1%
Routes	5	5	5	6	8	9	10	11	12	12	13	12	15	15	15	14	12.2%	3.1%

Source: Schiphol Counts data.
Reflects volumes for routes which represent at least one percent of total annual traffic between Schiphol and the United States.
Freight defined as thousands of metric tons.
Routes defined as all unique gateway airports transporting scheduled frieght to or from Schiphol.

Figure 3 shows that, once again, there was significant growth between 1992 and 1995, at which time the other European countries began to liberalise their air transport policies with the United States. The annual rate of growth of freight volume between 1992 and 1995 was 11.8 percent, while freight volume declined at an annual rate of 0.2 percent between 1995 and 2000. The annual rate of growth of freight routes declined from 5.7 percent between 1992 and 1995 to 1.5 percent between 1995 and 2000.

Figure 3

Transported Scheduled Freight Between Schiphol and the United States (1985 - 2000)



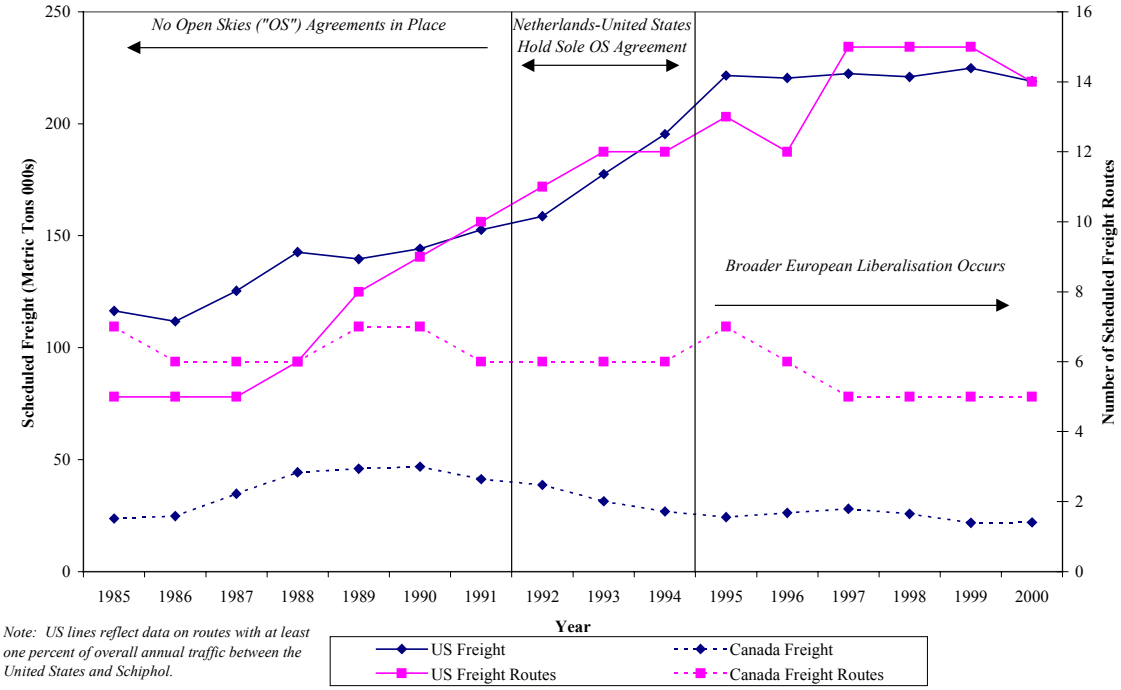
Note: Reflects data on routes with at least one percent of overall annual traffic between the United States and Schiphol.

We can again compare the Dutch experience with the United States to that with Canada to see if there was a general increase in freight traffic with North America. As seen in Figure 4, freight volumes between the Netherlands and Canada decreased after 1992, at the same time the freight with the United States was increasing. In particular, when the Netherlands-US freight traffic was increasing between 1992 and 1995,

Netherlands-Canada freight traffic was decreasing, and after 1995 they both levelled off. Canada did not experience similar increases in freight traffic as the United States after the Netherlands-US Open Skies agreement was signed, and in fact experienced losses in traffic with the Netherlands. This lends additional support to the contention that the Open Skies agreement appears to have been the cause of the increased freight traffic in the United States, and not general increases in Netherlands-North America freight traffic. There was probably some diversion of freight traffic between 1992 and 1995 from Canada to the United States, but the overall freight traffic increased between the Netherlands and the United States and Canada, so the Open Skies agreement appears to have led to an overall increase in freight traffic between Schiphol and the two countries.

Figure 4

Transported Scheduled Freight Between Schiphol and the United States vs. Canada (1985 - 2000)



Note: US lines reflect data on routes with at least one percent of overall annual traffic between the United States and Schiphol.

Conclusions from Simple Comparisons: Passenger and Freight Volumes and Routes

While we will discuss this issue in more detail below, the results presented in Table 1 and Table 2 suggest that it may have been beneficial for the Netherlands to liberalise its air transport policy with the United States before other European countries. Although the completion of aviation liberalisation (*i.e.*, Open Skies) agreements between the United States and other European countries was associated with a reduced growth rate of passenger traffic between the United States and the Netherlands, the annual growth rate of US-Netherlands passenger traffic during the Open Skies period (*i.e.,* 1992-2000) was still more than double that of the pre-Open Skies period (*i.e.*, 1985-1991). The growth of freight volumes, however, was slightly lower in the Open Skies period relative to the pre-

Open Skies period, though the decreases occurred primarily after the other European countries liberalised their air transport policies.

With respect to the impact of aviation liberalisation on the transatlantic route network served by Schiphol, the growth rate of transatlantic passenger routes and freight routes both declined under Open Skies. Again, as with freight volumes, a more substantial reduction in the growth rate of available routes occurred after the other European countries liberalised their aviation policies. It is possible that the significant network economies in freight transport, along with its intermodal structure, impose limitations on the number of transatlantic air routes needed to support efficient freight service.

The Netherlands-US Open Skies agreement apparently allowed Schiphol to increase its prominence as a hub for transatlantic traffic, primarily as a result of KLM's creation of a more extensive connecting network. As a result, Schiphol was able to maintain a strong growth rate of passenger volumes despite transatlantic liberalisation by nearby European countries. It is doubtful that Schiphol would have achieved the gains in passenger and freight volume and routes over the 1992 to 1995 period if other European countries had already liberalised their air transport policies with the United States.

One cautionary note is appropriate at this point. While the growth rate of passenger volumes increased markedly over Open Skies period (*i.e.*, 1992-2000), general macroeconomic conditions also improved markedly during this period relative to the latter part of the pre-Open Skies period. We will account for the impact of these economic factors later in this section.

4.B Development of the Netherlands-US Aviation Network under Open Skies

While Table 1 and Figure 1 indicate that more passengers were travelling between Schiphol and the United States, we also wanted to examine how the Netherlands-US aviation network was affected by the Open Skies agreement. Specifically, we wished to assess the extent to which passengers travelling from or through Schiphol were able to reach more destinations within the United States. One of the basic tenets of economics is more choice is better. Thus, if passengers travelling from or through Schiphol can reach more ultimate destinations (and/or reach them more frequently), they are likely to be better off.

Changes in US Connecting Traffic from Schiphol

Table 3 presents estimates of passenger volumes from Schiphol through selected gateway cities in the United States to other US destinations. The volume estimates are derived from the Survey data of passengers travelling from Schiphol. To preserve confidentiality, an index is used instead of the actual passenger volumes. The index is set equal to 100 in 1992 (the initial year of the Netherlands-US Open Skies agreement), which implies that passenger volumes in 1992 represent the "base" volume level. Thus, if an index increases from 100 in 1992 to 200 in another year, this implies passenger volumes in the other year are twice that of 1992. For gateways that did not exist in 1992,

the index is set equal to 100 in the first year that the city was used as a gateway for transferring passengers.

From Table 3, it is evident that large increases occurred under Open Skies in the number of passengers connecting through Detroit, Minneapolis, Miami, and (more recently) Seattle. Given the alliance between KLM and Northwest, the increased use of Detroit and Minneapolis is not surprising, since these two cities are Northwest's two largest hubs. Overall, by 1998 the total number of connecting passengers more than doubled after the Open Skies agreement was signed with the United States.

Table 3

Summary of Negative Transfer from Schiphol through United States (1992 = 100*)

Passengers flying from Schiphol to North America, Middle America, and Latin America through specified gateway city on scheduled flights

Gateway City	*Number of Passengers from Schiphol to Destination through Gateway*								*Average Percentage Increase [1]*
	1986	*1988*	*1990*	*1992*	*1994*	*1996*	*1998*	*2000*	
Atlanta	53	50	81	100	65	69	95	99	25%
Baltimore-Washington	-	-	151	100	-	-	-	-	n/a
Boston	-	33	122	100	81	33	40	30	-33%
Chicago	131	152	142	100	72	51	70	68	-55%
Detroit	-	4	1	100	195	482	601	966	17425%
Houston	56	43	57	100	158	188	168	144	230%
Los Angeles	108	105	105	100	50	109	140	110	-6%
Memphis	-	-	-	-	-	100	119	122	n/a
Miami **	-	-	-	-	100	228	185	158	n/a
Minneapolis-St. Paul	-	-	-	100	442	695	691	731	n/a
New York - JFK	116	108	106	100	54	49	45	58	-55%
Newark	-	-	-	-	100	250	2,273	8,105	n/a
Orlando	-	9	94	100	77	76	62	30	39%
San Francisco	-	-	-	-	100	99	178	140	n/a
Seattle	-	-	-	-	100	51	752	1,445	n/a
Washington-Dulles	-	-	-	-	100	167	282	205	n/a
Total	68	71	88	100	110	175	218	269	122%

Source:
Schiphol Survey data.
Notes:
** For cities where 1992 volumes are zero, index is set to 100 for first available year subsequent to 1992.*
*** The index value for Miami in 1986 is less than one and is not considered in this analysis.*
[1]: Average percentage increase expresses increase in the average index values in 1994, 1996, and 1998 over the average index values in 1986, 1988, and 1990 in percentage form.

Table 4 shows the same gateway cities, except in this case we provide estimates of the number of ultimate US city destinations that were reached from each gateway. Again, there were large increases in the number of destinations that were reached from the four cities registering large increases in the number of connecting passengers (Detroit, Minneapolis, Miami, and Seattle). It also appears that there were significantly more connecting flights through Atlanta.

The overall totals at the bottom of Table 4 can be slightly misleading. Since the same ultimate destination may be reached from two different gateways, these totals may involve double counting if the intention is to describe growth in origin-destination city pairs that can be reached from Schiphol. However, let a "route" be defined as a trip from Schiphol to a unique US destination through a US gateway, or a trip to the same US destination through a different US gateway. Based on this definition, the average number

of routes between Schiphol and the United States in the 1994-1998 period after Open Skies was twice that of the 1986-1990 period before Open Skies.

Table 4

Summary of Negative Transfer from Schiphol through United States (1992 = 100*)

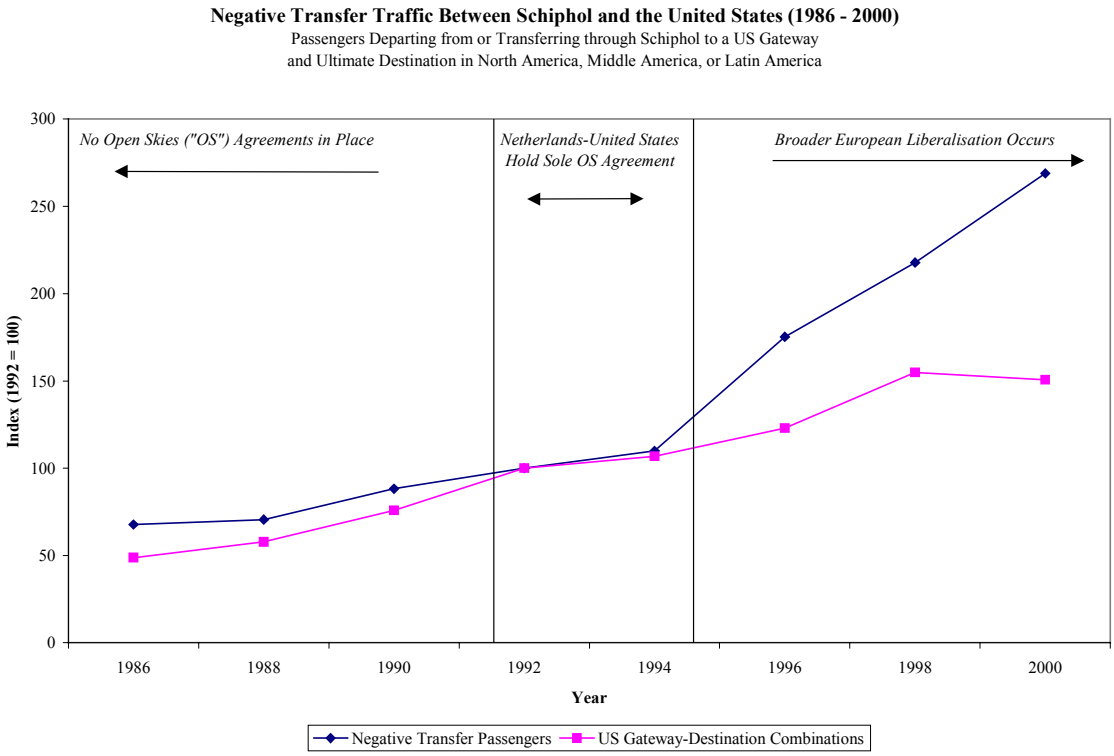
Number of ultimate destinations for passengers flying from Schiphol to North America, Middle America, and Latin America through specified gateway city on scheduled flights

Gateway City	*Number of Ultimate Destinations From Schiphol through Gateway*								*Average Percentage Increase [1]*
	1986	*1988*	*1990*	*1992*	*1994*	*1996*	*1998*	*2000*	
Atlanta	48	44	81	100	93	72	107	135	57%
Baltimore-Washington	-	-	85	100	-	-	-	-	n/a
Boston	-	64	102	100	98	67	81	52	-2%
Chicago	75	72	97	100	71	63	80	39	-12%
Detroit	-	17	4	100	133	176	196	211	1555%
Houston	27	77	83	100	63	67	73	52	8%
Los Angeles	112	116	104	100	80	96	116	76	-12%
Memphis	-	-	-	-	-	100	138	118	n/a
Miami **	-	-	-	-	100	167	213	207	n/a
Minneapolis-St. Paul	-	-	-	100	233	253	263	250	n/a
New York - JFK	103	90	98	100	67	79	64	55	-28%
Newark	-	-	-	-	100	350	1,700	3,550	n/a
Orlando	-	14	71	100	86	29	71	36	44%
San Francisco	-	-	-	-	100	122	233	122	n/a
Seattle	-	-	-	-	100	200	700	1,450	n/a
Washington-Dulles	-	-	-	-	100	122	156	146	n/a
Total	49	58	76	100	107	123	155	151	111%

Source:
Schiphol Survey data.
Notes:
** For cities where 1992 volumes are zero, index is set to 100 for first available year subsequent to 1992.*
*** The index value for Miami in 1986 is less than one and is not considered in this analysis.*
[1]: Average percentage increase expresses increase in the average index values in 1994, 1996, and 1998 over the average index values in 1986, 1988, and 1990 in percentage form.

Figure 5 graphs the index values for the total number of negative transfer passengers and the total number of ultimate destinations from Table 3 and Table 4. It shows that unlike the previous analysis, there was not a marked difference between the period 1992-1995 and 1995-2000. While the growth rate of connecting passengers at major gateways appears to have increased after 1995, the number of connecting routes grew at about the same rate in both periods. Between 1998 and 2000, the number of connecting routes actually declined. Nonetheless, Figure 5 shows that the number of connecting passengers increased by slightly less than 50 percent in the six years before the Open Skies agreement, but this number more than doubled in the six years after Open Skies began. This result suggests that Open Skies facilitated the development of a feeder network into transatlantic gateway-to-gateway traffic.

Figure 5



Changes in European Connecting Traffic to Schiphol

We also examined whether Schiphol became more utilised as a gateway between Europe and the United States. Table 5 shows for European Union destination countries estimates of the number of connecting passengers through Schiphol and the number of city-pairs that were reached from the United States through Schiphol. Since these numbers were derived from the Survey data, we have again presented them in index form to preserve confidentiality.

As observed in Panel A of Table 5, large increases arose after 1992 in average passenger volumes travelling through Schiphol. Panel B of Table 5 indicates that substantial increases arose after 1992 in the average number of city-pairs that were reached through Schiphol after the Netherlands-US Open Skies agreement went into effect. When comparing the average of the 1986-90 period before Open Skies with the average of the 1994-98 period after Open Skies went into effect, we find that the number of city-pairs approximately doubled and the number of passengers between the United States and the European Union more than tripled.

Table 5

Summary of Positive Transfer at Schiphol between United States and European Union (1992 = 100)

EU Member	***Panel A: Passengers Transferring from United States to European Union via Schiphol***								*Average Percentage Increase [1]*
	1986	1988	1990	1992	1994	1996	1998	2000	
Austria	41	58	77	100	187	278	269	384	318%
Belgium	63	78	68	100	113	134	129	107	80%
Denmark	49	91	81	100	130	164	242	255	142%
Finland	69	160	116	100	252	378	523	666	235%
France	73	56	65	100	147	194	362	341	263%
Germany	43	60	65	100	162	205	202	230	239%
Greece	156	155	180	100	174	195	259	252	28%
Ireland	42	36	15	100	125	441	624	739	1178%
Italy	37	40	57	100	139	204	268	196	357%
Luxembourg	21	21	57	100	356	424	604	430	1304%
Netherlands	-	-	-	-	-	-	-	-	n/a
Portugal	67	79	81	100	146	437	583	880	413%
Spain	53	64	48	100	106	172	279	406	237%
Sweden	26	39	45	100	164	228	237	308	476%
United Kingdom	34	50	63	100	123	191	249	316	282%
Total	48	61	67	100	147	202	246	274	238%

EU Member	***Panel B: Airport Pairs from United States to European Union via Schiphol***								*Average Percentage Increase [1]*
	1986	1988	1990	1992	1994	1996	1998	2000	
Austria	50	50	80	100	110	150	150	140	128%
Belgium	60	90	90	100	120	160	160	140	83%
Denmark	60	60	70	100	120	130	150	140	111%
Finland	56	56	89	100	122	144	156	144	111%
France	60	60	90	100	120	150	170	140	110%
Germany	60	70	90	100	140	160	190	150	123%
Greece	60	60	80	100	130	130	160	140	110%
Ireland	100	80	40	100	100	200	220	200	136%
Italy	60	80	90	100	110	140	170	140	83%
Luxembourg	33	33	78	100	122	133	167	144	192%
Netherlands	-	-	-	-	-	-	-	-	n/a
Portugal	43	86	71	100	86	157	171	171	107%
Spain	67	67	89	100	122	144	156	144	90%
Sweden	60	70	80	100	110	130	170	140	95%
United Kingdom	60	70	90	100	130	150	180	150	109%
Total	58	66	82	100	119	147	167	147	110%

Source:
Schiphol Survey data.
Notes:
[1]: Average percentage increase expresses increase in the average index values in 1994, 1996, and 1998 over the average index values in 1986, 1988, and 1990 in percentage form.

It is once again interesting to note the pattern of the increases over time. Figure 6 shows the increases in passenger traffic from Table 5, Panel A for a select group of the countries. Once again, we see that Schiphol experienced increases in traffic volumes up until the time the other counties began to liberalise their air transport policies with the United States, at which point the increases in traffic began to slow their rate of growth. A good example is Germany, which signed an Open Skies agreement with the United States in 1996. As the graph demonstrates, traffic between the United States and Germany through Schiphol increased after 1992 until 1996, when the Germany-US Open Skies agreement was signed, at which point traffic increased at approximately its 1986-1992 rate of growth. With regards to the United Kingdom, traffic through Schiphol appears to have continued a constant increase after 1992, which fits with the fact there is no Open Skies agreement between the United States and the United Kingdom. Italy signed its Open Skies agreement with the United States in November 1998, and as the graph indicates, US-Netherlands-Italy traffic only began to decrease after that time. And while the French did not sign an Open Skies agreement with the United States until October 2001, there was a major liberalisation in its air transport policy with the United States in

April 1998. This, too, is reflected in the drop in traffic through Schiphol between the United States and France after 1998. Once again, the graph indicates Dutch leadership in air liberalisation led to increased levels of traffic through Schiphol that persisted after other European countries signed Open Skies agreements with the United States, even as the rates of growth slowed in the face of increased competition over transatlantic travel from the other European countries.

Figure 6

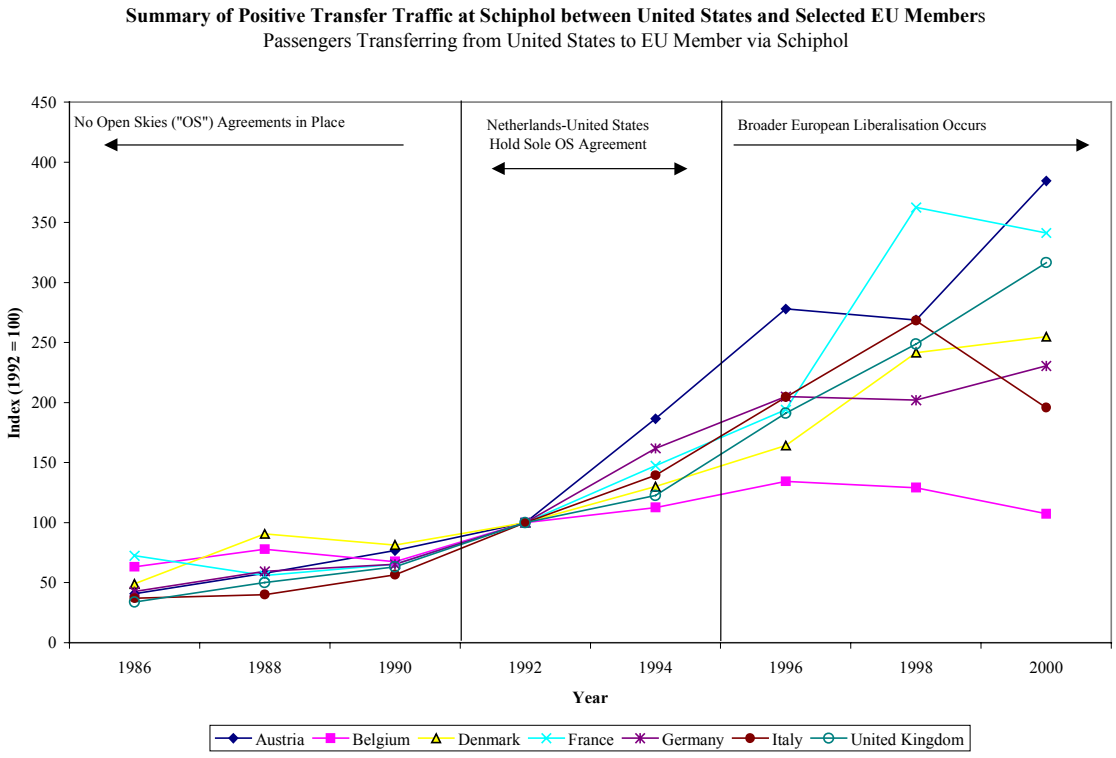


Table 6 is similar to Table 5, except it shows the transatlantic traffic flows in the other direction: from Europe to the United States through Schiphol. Once again, increases occurred which persisted, albeit at a slower rate of growth, once the other European countries liberalised their air transport policies with the United States.

Table 6

Summary of Positive Transfer at Schiphol between United States and European Union (1992 = 100)

EU Member	***Panel A: Passengers Transferring from European Union to United States via Schiphol***								*Average Percentage Increase [1]*
	1986	1988	1990	1992	1994	1996	1998	2000	
Austria	54	34	141	100	309	354	441	479	382%
Belgium	98	98	110	100	181	183	179	163	77%
Denmark	54	53	70	100	115	157	234	322	187%
Finland	100	97	30	100	191	254	298	408	228%
France	95	61	96	100	145	219	480	406	236%
Germany	39	65	72	100	182	211	241	261	261%
Greece	147	135	138	100	121	148	242	191	22%
Ireland	70	26	118	100	143	529	1,034	1,057	699%
Italy	47	47	69	100	171	260	375	261	394%
Luxembourg	36	44	100	100	401	434	852	436	833%
Netherlands	-	-	114	100	110	221	243	232	68%
Portugal	33	88	17	100	343	385	594	1,401	862%
Spain	43	39	45	100	111	227	289	255	395%
Sweden	28	49	51	100	175	235	243	302	408%
United Kingdom	41	42	65	100	112	193	244	296	269%
Total	52	58	76	100	158	214	277	287	249%

EU Member	***Panel B: Airport Pairs from European Union to United States via Schiphol***								*Average Percentage Increase [1]*
	1986	1988	1990	1992	1994	1996	1998	2000	
Austria	25	25	50	100	75	75	75	100	125%
Belgium	100	100	100	100	100	100	100	100	0%
Denmark	50	50	50	100	100	150	150	100	167%
Finland	200	100	100	100	100	100	100	100	-25%
France	57	86	71	100	100	114	143	114	67%
Germany	100	120	120	100	90	140	150	150	12%
Greece	150	150	100	100	100	150	100	100	-13%
Ireland	100	100	100	100	100	100	200	200	33%
Italy	40	60	60	100	100	120	140	140	125%
Luxembourg	100	100	100	100	100	100	100	100	0%
Netherlands	-	-	67	100	100	133	100	67	67%
Portugal	100	100	50	100	150	150	100	50	60%
Spain	80	80	100	100	80	100	120	80	15%
Sweden	67	67	100	100	100	100	100	100	29%
United Kingdom	61	72	83	100	100	106	122	106	51%
Total	70	79	85	100	97	115	124	111	44%

Source:
Schiphol Survey data.
Notes:
[1]: Average percentage increase expresses increase in the average index values in 1994, 1996, and 1998 over the average index values in 1986, 1988, and 1990 in percentage form.

Conclusions from Development of the Netherlands-US Aviation Network under Open Skies

The results summarised in Figure 5 and Figure 6 suggest that the Open Skies agreement between the Netherlands and the United States led to a boom in connecting traffic travelling between Schiphol and the United States. This includes passengers that originated or terminated in the United States at airports that were not transatlantic gateways. It also includes sharp increases in passengers that originated or terminated in other European countries and travelled through Schiphol on their way to or from the United States. Hence, simple comparisons suggest that the Netherlands-US Open Skies agreement may have had a profound influence on Schiphol's development as a hub airport.

This is an intuitive finding. The liberalisation of transatlantic aviation through an Open Skies agreement should lead to an increase in transatlantic gateway-to-gateway

competition, resulting in more flights and a wider array of gateways.[17] As a result, the airlines offering gateway-to-gateway service begin competing for additional transatlantic traffic to feed into the gateways. Consequently, an expansion occurs in the frequency and network of flights feeding into transatlantic gateways, leading to consumer benefits in the form of lower fares and improved service.

The formation of alliances, such as the KLM-Northwest alliance, can facilitate the development of networks feeding into transatlantic gateways and lead to co-ordinated reductions in fares for transatlantic passengers originating behind or travelling beyond transatlantic gateways. This effect of alliances on transatlantic connecting traffic has been documented in economic reports and studies on international aviation.[18]

4.C CARRIER COMPETITION

Another question of interest is whether there has been a shift in the composition of carriers flying between Schiphol and the United States since the Open Skies agreement was signed in 1992. The previous restrictive agreement between the United States and the Netherlands limited the number of city-pair routes served between the United States and the Netherlands. Economic theory predicts that liberalisation would induce increased competition, both in terms of the number of routes served and the number of carriers on those routes.

To gain more insight into the effect of Open Skies on competition, we analysed the number of carriers on a given route. We calculated the total passenger traffic between Schiphol and each relevant US city between 1985 and 2000. Then, we chose the top twelve cities — each of which had over one million total passengers over this time period.[19] Lastly, we counted the number of unique carriers that served a given route for at least six months out of the year. This method identifies carriers serving the route on a consistent basis.

Table 7 shows the results of our analysis. For eight of the twelve cities — Chicago, Detroit, Los Angeles, Minneapolis-St. Paul, New York, Newark, San Francisco, and Washington — the number of carriers serving the city increased after completion of the Open Skies agreement. Six of the cities maintained this increased number of competitors through 2000. Three city-pair routes (Newark, San Francisco, and Washington, DC) were

[17] As noted in footnote 15, liberalisation may not lead to more gateways if an alliance forms and rationalises its network before others can enter. This may have occurred with the KLM-Northwest alliance.

[18] For reference, see US Department of Transportation, *International Aviation Developments (First Report)*, December 1999 and *International Aviation Developments (Second Report)*, October 2000. Also, see Jan K. Brueckner and W. Tom Whalen, "The Price Effects of International Airline Alliances", *Journal of Law & Economics* 43, no. 2 (October 2000): 503-545.

[19] By choosing the top twelve cities in terms of passenger volume, we were attempting to identify the number of competitors on high-volume routes. In looking at volumes over the entire period, we allowed for new routes that came into existence and were subject to high passenger volumes.

not served prior to Open Skies,[20] and all three had multiple carriers serving them by the end of our data period. Detroit and Minneapolis-St. Paul benefited from the KLM-Northwest alliance in terms of increased service frequency, since these cities are Northwest's two largest hubs.

Table 7

Number of Carriers Serving Top 12 Scheduled Passenger Routes Between United States and Schiphol (1985 - 2000)

Airport	*Year*															
	1985	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Atlanta	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
Boston	0	0	0	1	2	1	1	1	1	1	1	1	1	1	1	1
Chicago	3	2	1	1	2	1	2	2	3	3	2	4	4	4	4	4
Detroit	1	0	0	1	1	0	0	1	1	1	2	2	2	2	2	2
Houston	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Los Angeles	2	3	1	1	2	2	2	2	2	3	3	3	3	3	2	1
Minneapolis-St. Paul	0	0	0	0	0	0	1	1	1	1	2	2	2	2	2	2
New York	6	5	6	5	5	4	6	6	5	7	8	7	6	4	3	4
Newark	0	0	0	0	0	0	0	0	0	0	1	0	1	2	3	3
Orlando	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
San Francisco	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2
Washington, DC	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2

Sources and Notes:
Schiphol Counts data.
Carrier must serve city for at least six months out of the year to be considered in analysis.

Admittedly, counting the number of carriers is a very crude way of assessing the extent of competition on a given route. For example, suppose that a single carrier served a particular city-pair route prior to Open Skies. This carrier would likely be charging monopoly, or near-monopoly, airfares. After Open Skies, if another carrier entered the route, we would be tempted to say that competition had increased substantially. However, if the incumbent carrier maintained a 95 percent share of the passenger traffic even after entry, fares might not drop far below monopoly levels. The low market share of the entrant may reflect competitive disadvantages facing that firm, such as higher costs, lower quality, or reduced customer recognition.

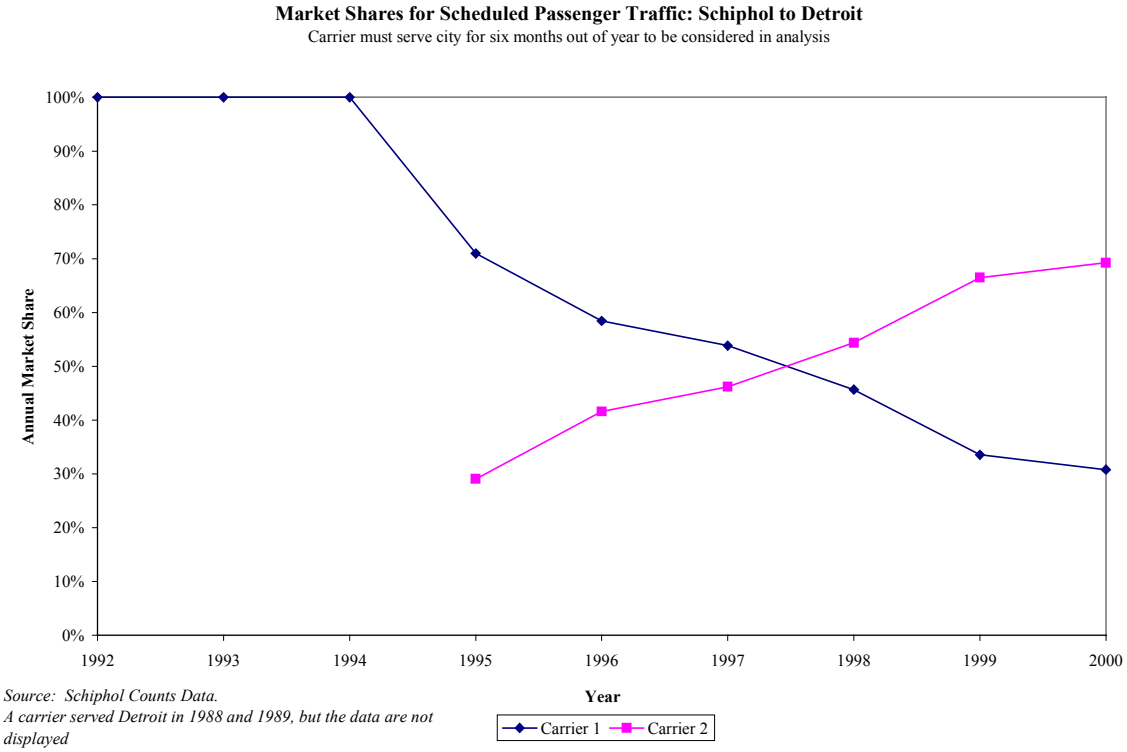
Absent a more considered assessment of cost and demand conditions facing each airline, as well as the nature of competitive interaction in each market, it is instructive to examine the behaviour of market shares over time. Accordingly, we calculated the market share of each carrier on the four highest volume routes. Due to confidentiality concerns, we do not refer to any carrier by name. Nonetheless, we are still able to observe the gains and losses in market share of individual carriers.

Figure 7 through Figure 10 present these results. In the Detroit-Schiphol market (Figure 7), Carrier 2 shows a large increase in market share, with a corresponding decline in Carrier 1's market share. In the Los Angeles-Schiphol market (Figure 8), Carriers 3 and 4 enter after the Open Skies agreement was signed. In the Minneapolis-Schiphol market (Figure 9), Carrier 2 replaced Carrier 1 in the early 1990s. After Carrier 1 re-entered the market, both carriers had relatively equal market shares by the end of our data period. Finally, in the New York-Schiphol market (Figure 10), which has the greatest

[20] San Francisco did have traffic with Schiphol in 1986, but not in any other year prior to 1993. Before Open Skies, no carrier met our criteria of flying between San Francisco and Schiphol for at least six months of the year.

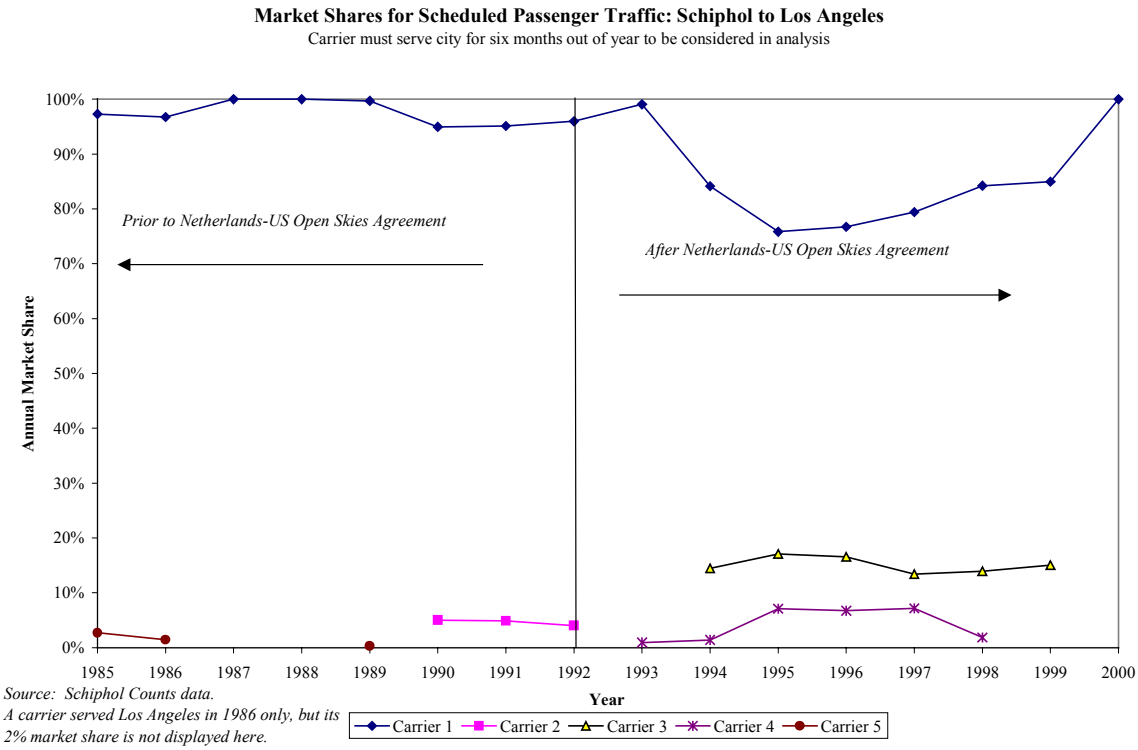
city-pair passenger volume, three new carriers (Carriers 2, 4, and 5) entered after the Open Skies agreement was consummated. Although the New York-Schiphol and Los Angeles-Schiphol results indicate that one carrier accounts for the predominant share of the market, other airlines have been able to enter periodically and gain market share.

Figure 7



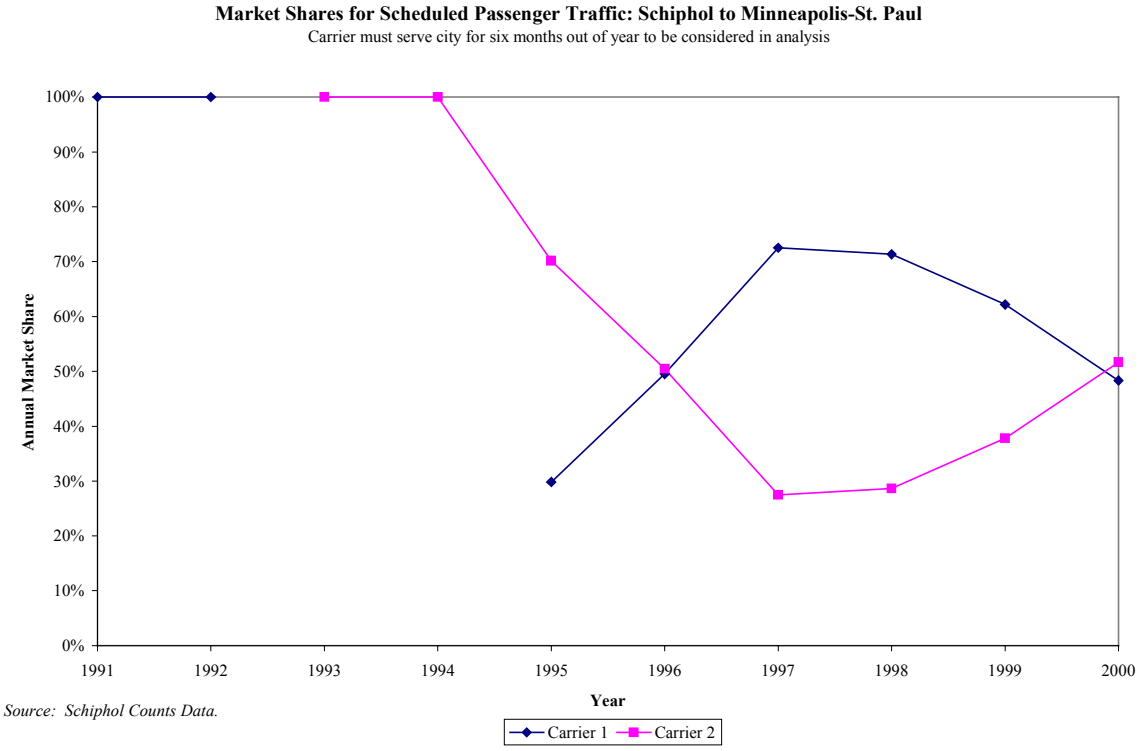
Source: Schiphol Counts Data.
A carrier served Detroit in 1988 and 1989, but the data are not displayed

Figure 8



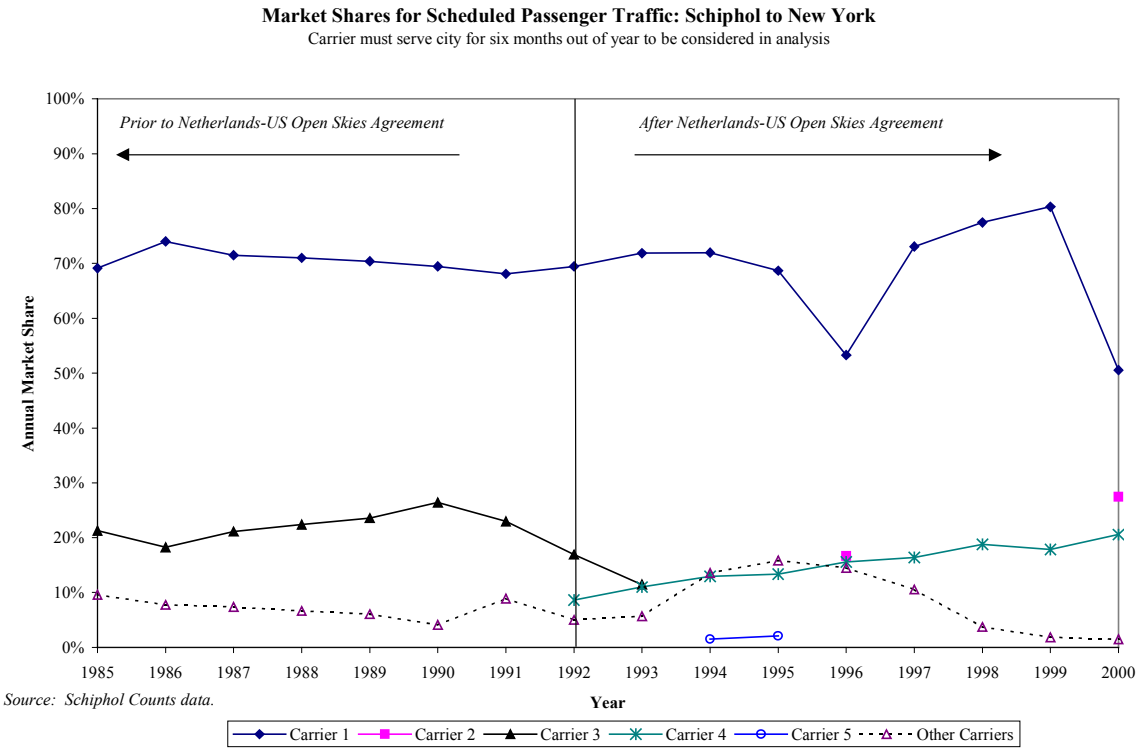
Source: Schiphol Counts data.
A carrier served Los Angeles in 1986 only, but its 2% market share is not displayed here.

Figure 9



Source: Schiphol Counts Data.

Figure 10



Conclusions from Carrier Competition

It appears that the Open Skies agreement between the Netherlands and the United States induced entry into new and existing routes. In the case of traffic between Schiphol and Detroit or Minneapolis-St. Paul, we have witnessed erosion of the market share of the airline that dominated these routes prior to Open Skies. However, it is difficult to assess the relationship between these market share changes and the nature of competitive interaction. With respect to the other two cities examined (New York and Los Angeles), new carriers were able to enter and compete on those routes after the Open Skies agreement was signed. Based purely on the number of competitors, it appears from this analysis that Open Skies has led to greater competition among carriers. However, it is difficult to reach more definitive conclusions without a more thorough empirical analysis of the nature of competitive interaction and firm cost and demand conditions.

4.D Regression Analysis: Out-of-Sample Predictions

Statistical regression methods also were used to assess the impact of the Netherlands-US Open Skies agreement on transatlantic passenger volumes. The performance of the Netherlands under its Open Skies agreement with the United States was contrasted with that of Belgium and Germany after they entered into similar agreements with the United States. A summary of our results is presented in this subsection, while the model specifications and estimation techniques are described in detail in Appendix I.

General Description of Regression Analysis and Model Specification

Since regression analysis is used to isolate the impact of individual economic factors when several factors change at the same time, it is a potentially valuable tool for separating the impact of an Open Skies agreement from the impact of cost and demand changes. This is particularly important in light of the robust economic growth in the United States and elsewhere that occurred during the past decade, which naturally would have stimulated increased passenger volumes by itself.

To perform our statistical analysis of the impact of Open Skies, we formed a common data set of transatlantic passenger volumes on flight segments between the United States and Austria, Belgium, France, Germany, Italy, the Netherlands, and Portugal. In order to rely on a single data source for passenger volumes, we used the US Department of Transportation's T-100 International Databank containing monthly observations of passenger volumes on city-pair flight segments from 1990 to 2000. We aggregated to quarterly totals for use in the regressions. Given that the intent of our analysis was to generate predictions of passenger volumes that would have been expected without an Open Skies agreement, the model relationships were estimated using only data for the period prior to each country's Open Skies agreement.

The model specification related passenger volumes on city-pair flight segments to general cost and demand conditions, as well as market-specific factors. For Netherlands-US city pairs, the following variables were used:

- an airline cost index
- US disposable income
- the Dutch gross domestic product (GDP)
- the "real" Netherlands-US exchange rate (*i.e.,* an "inflation adjusted" exchange rate)
- quarterly indicator variables
- route indicator variables
- an "age" variable for new city-pair routes

For the city pairs between the US and the other European countries, analogous variables were used, except the European countries' GDP and exchange rates replaced the appropriate Dutch variables.

By applying regression techniques, coefficients were estimated for each variable, using observations only for the pre-Open Skies period. The coefficient estimates describe the quantitative relationship between a change in a given variable (*e.g.*, airline costs) and the associated change on passenger volumes.

Having obtained coefficient estimates that relate the impact of cost and demand factors to passenger volumes during the pre-liberalisation period, we then use these coefficients to predict passenger volumes based on the actual cost and demand conditions

observed during the post-liberalisation period. Essentially, these predictions represent estimates of passenger volumes that would be expected to arise if no liberalisation had occurred.

If market behaviour remained the same before and after liberalisation, the predicted passenger volumes should not differ systematically from the observed passenger volumes after liberalisation. If liberalisation affected the number of passengers by changing market behaviour, then there should be a systematic difference in the predicted volume of passenger traffic and the observed volume of passenger traffic after liberalisation.

Although we estimated the model over all seven countries, we will only present the results for the Netherlands, Belgium, and Germany. These three countries are of the most interest to us. The Netherlands, obviously, is included because we want to know the impact of the Netherlands-US Open Skies agreement on Netherlands-US traffic. The other two countries will be useful in determining whether the Netherlands experienced a first-mover advantage in liberalising its air transport policy, and whether these two countries, which liberalised closest in time to the Netherlands' liberalisation, had results that were similar to those of the Netherlands.

Prediction Results

The first and second columns of Table 8 compare actual transatlantic passenger volumes under liberalisation (*i.e.*, Open Skies) with the predictions of our regression model. The actual passenger numbers include both existing pre-Open Skies routes as well as new routes that came into existence after the agreements were signed. However, the predicted volumes only account for the volume on pre-existing routes. By definition, city-pair routes that came into existence during the Open Skies period had no passenger volumes prior to Open Skies. Our analysis essentially assumes that no service would have been provided on these routes in the absence of an Open Skies agreement.

The third and fourth columns of Table 8 show, respectively, the absolute difference and the percentage difference in the actual and predicted number of passengers during the Open Skies period.

Table 8

Summary of Predicted vs. Actual Transatlantic Scheduled Passenger Traffic ('000s)

Country	*Actual Passenger Traffic in Post-Open Skies Period [1]*	*Predicted Passenger Traffic in Post-Open Skies Period [2]*	*Actual Less Predicted Passenger Traffic*	
			Amount [3] = [1] - [2]	*Percent of Predicted [4] = [3] / [2]*
Belgium	5,896	6,845	-948	-14%
Germany	31,404	32,239	-835	-3%
Netherlands	27,232	17,984	9,248	51%
Total	***64,532***	***57,068***	***7,464***	***13%***

Source:
US DOT T-100 International Databank.
Note:
For each country, actual and predicted volumes are summed over the entire post-Open Skies agreement period, which is 1995Q2 - 2000Q4 for Belgium, 1996Q1 - 2000Q4 for Germany, and 1992Q4 - 2000Q4 for the Netherlands.

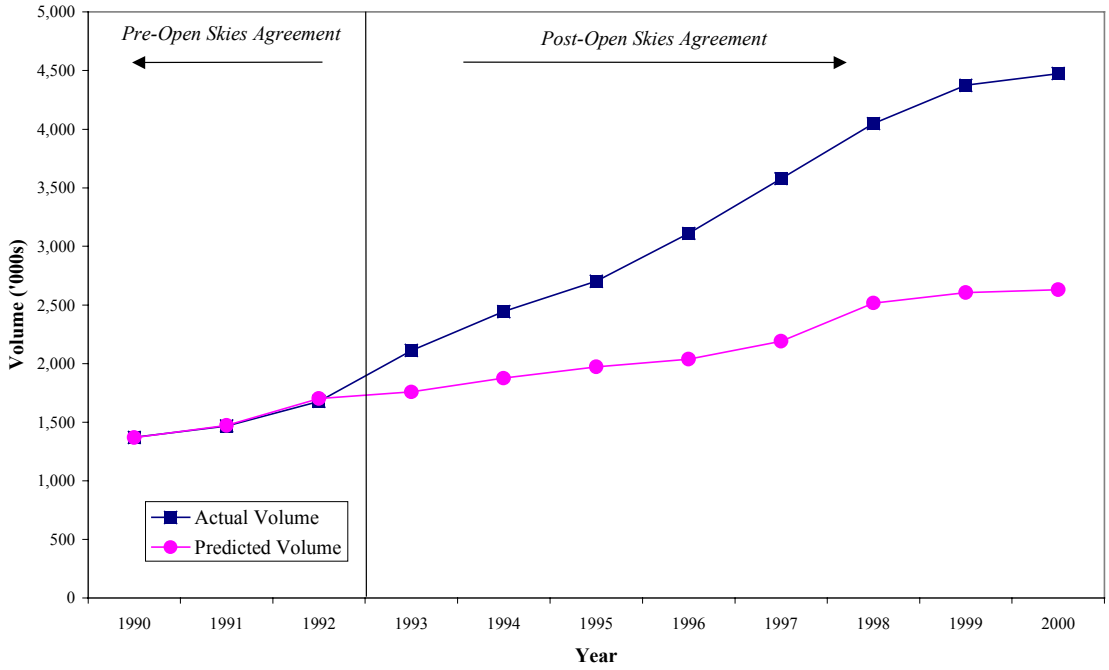
From Table 8, we see that the actual passenger volume exceeded the predicted passenger volume for the Netherlands by 51 percent. Hence, the actual number of transatlantic passengers between the Netherlands and the United States in the Open Skies period substantially exceeded the number of passengers that would have been predicted in the absence of Open Skies. By contrast, our results suggest that Belgium and Germany experienced lower passenger volumes after their Open Skies agreements went into effect compared to the predicted levels.

Although transatlantic liberalisation by itself would likely result in increased competition, reduced fares, and increased passenger volumes, it must be noted that the Netherlands-US Open Skies agreement preceded the Belgium-US Open Skies agreement by more than two years and the Germany-US Open agreement by more than three years. Thus, the expansion of Schiphol as a hub airport for transatlantic and intra-European travel prior to Belgian and German liberalisation may have diverted passengers away from Belgian and German gateway airports. This process may have accelerated over time, offsetting the benefits of Belgian and German liberalisation.

We also have included a visual representation that better demonstrates the substantial changes in passenger volumes that arose under liberalisation. Figure 11 shows the actual passenger volumes between the United States and the Netherlands, as compared to the predicted volumes. The passenger growth rate under Open Skies far exceeded the growth rate that was predicted to occur if the prior aviation regime had remained in effect.

Figure 11

Predicted vs. Actual Transatlantic Passenger Volumes: Netherlands



We have also included below the corresponding figures for Belgium and Germany.

Figure 12

Predicted vs. Actual Transatlantic Passenger Volumes: Belgium

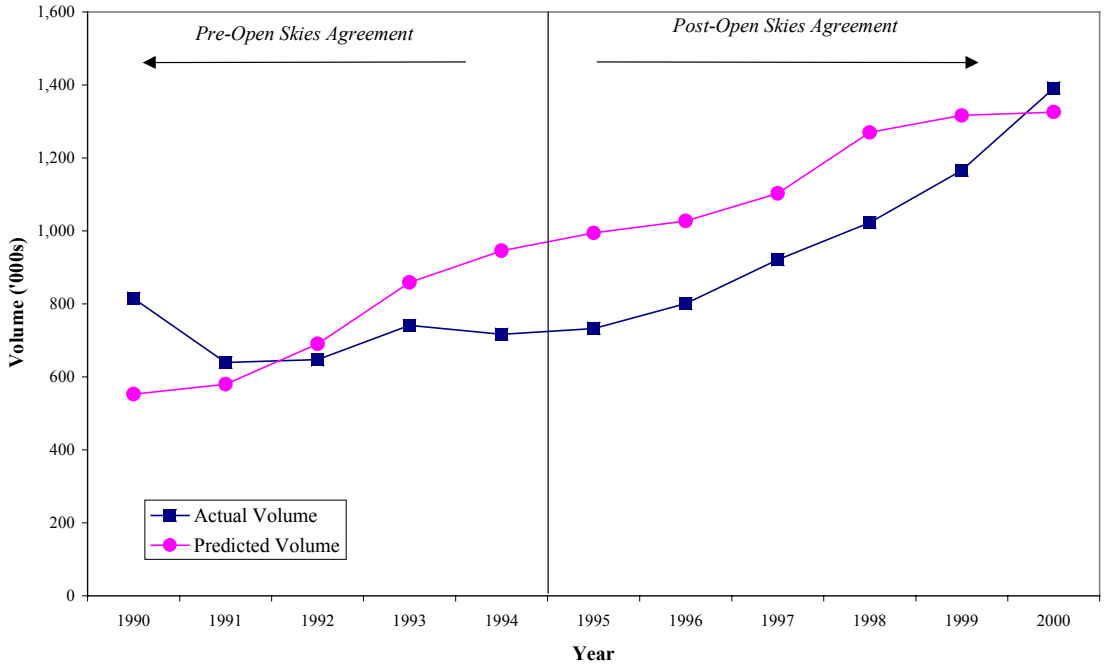
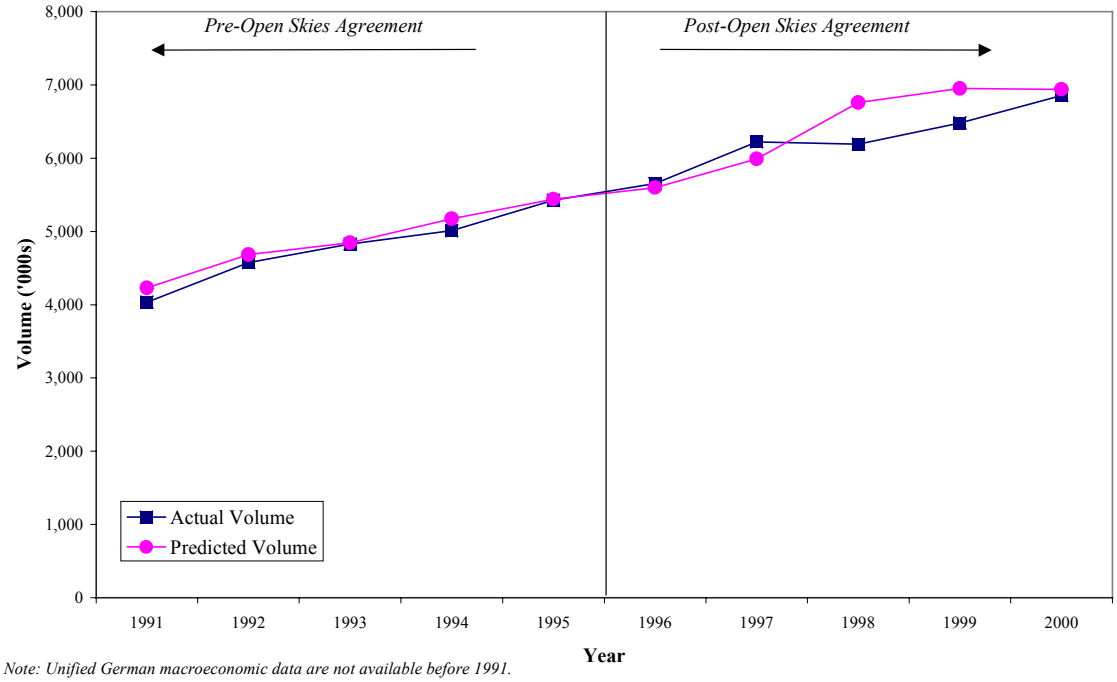


Figure 13

Predicted vs. Actual Transatlantic Passenger Volumes: Germany



Note: Unified German macroeconomic data are not available before 1991.

Conclusions

Using simple comparisons and regression methods, we find that the Netherlands in general, and Schiphol in particular, has benefited from the Open Skies agreement with the United States. Transatlantic passenger volumes between the Netherlands and the United States are higher than they would have been if no liberalisation had occurred, and Schiphol's role as a hub for transatlantic and intra-Europe aviation traffic also appears greater as a result of this agreement.

Moreover, judging by the out-of-sample predictions from our regression model, the Netherlands fared better under its Open Skies agreement with the United States relative to Belgium and Germany. It is therefore quite possible that substantial first-mover benefits accrued to the Netherlands by reaching an Open Skies agreement before neighbouring countries.

5. Liberalisation between the Netherlands and Other Countries

This section uses many of the same analytical techniques that were applied previously in assessing the economic impact of Netherlands-US aviation liberalisation. However, in this section, we examine the impact of three other cases of international aviation liberalisation by the Netherlands. These cases include liberalisation with Kenya, Malaysia, and Brazil.

5.A KENYA

Description of Previous and Present Aviation Agreements with the Netherlands

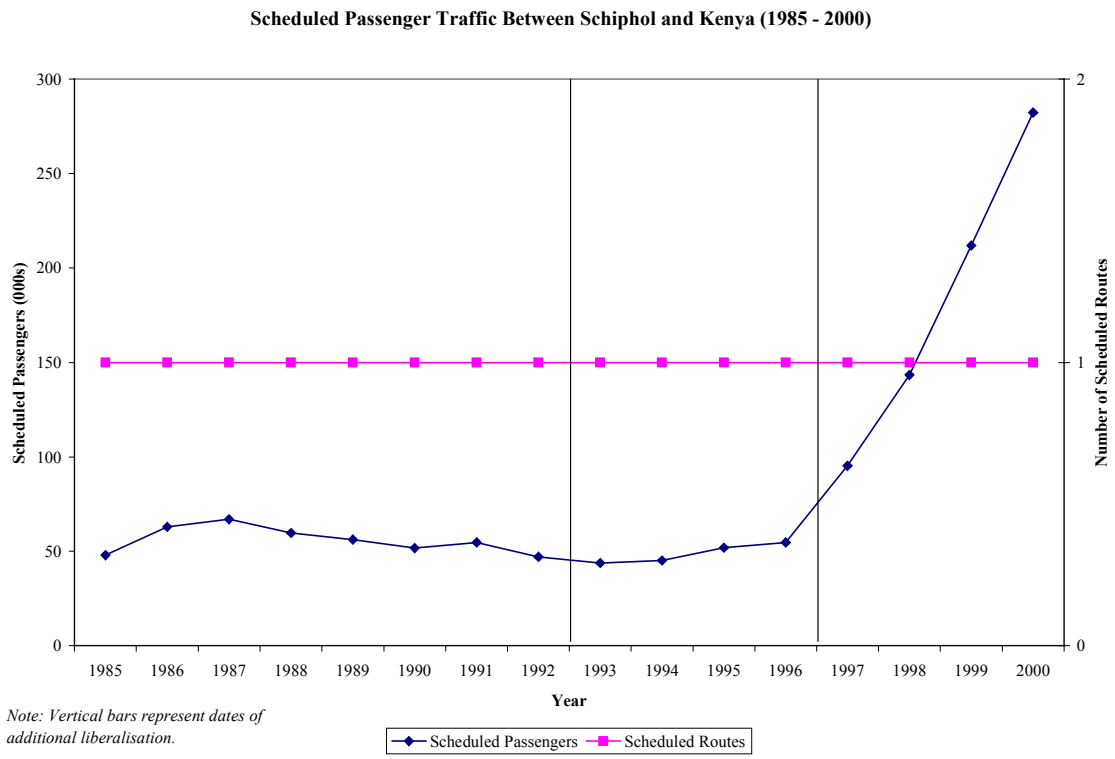
The Netherlands entered into a series of aviation agreements with Kenya over the past two decades. In May 1979, an Aviation Services Agreement (ASA) was signed covering the following routes: (i) Netherlands-Munich/Vienna-Cairo-Nairobi-a point beyond, and (ii) Netherlands-Nairobi-Johannesburg. Then, in August 1993, another liberalisation occurred covering additional routes and flight frequencies. Finally, in May 1997, another agreement was signed that vastly liberalised travel between the two countries—both in terms of more flights and more destinations.

Simple Comparisons

Passenger Volumes and Routes

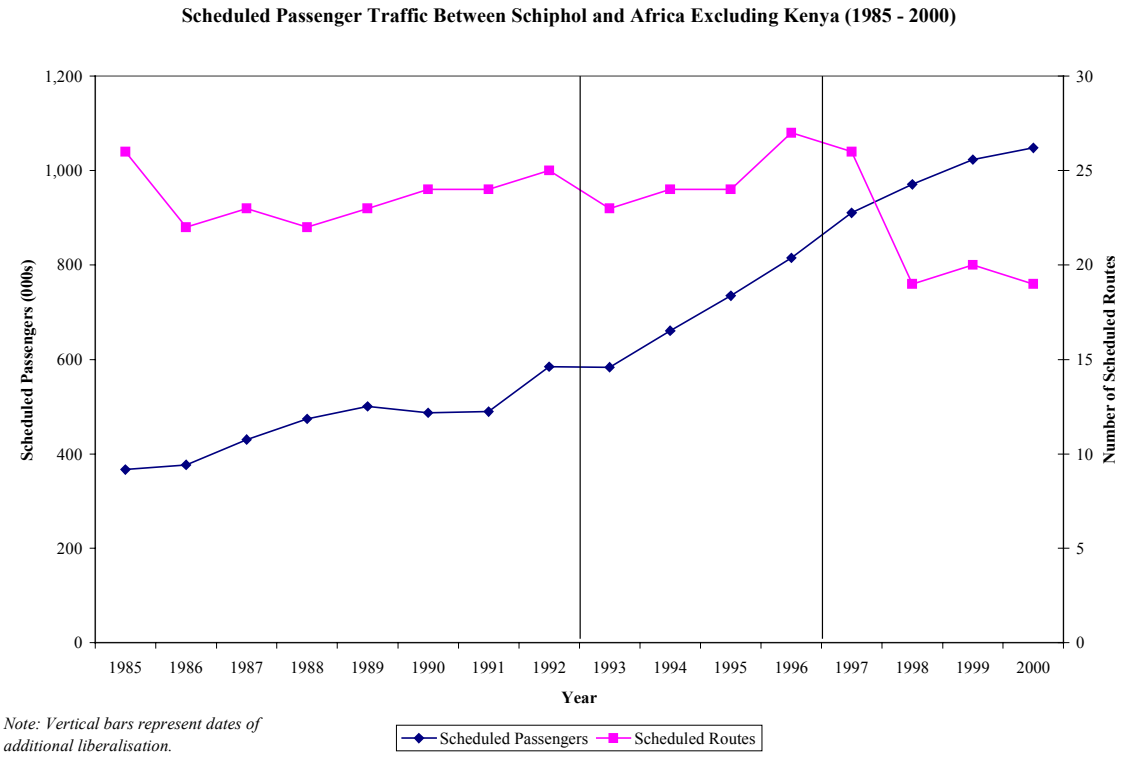
Figure 14 shows the evolution of passenger traffic volume between Schiphol and Nairobi between 1985 and 2000. Passenger volume was basically flat between 1985 and 1996, and then started increasing rapidly after the more liberal agreement was signed in 1997. By the year 2000, the number of passengers between Schiphol and Nairobi was more than five times the passenger volume in 1996.

Figure 14



This figure can be compared to the results for the rest of the continent to see if the Kenyan patterns were merely indicative of overall increases in traffic between Schiphol and Africa. As can be seen from Figure 15, the Kenyan patterns are not replicated in the rest of the continent. Although there appears to have been relatively steady passenger volume growth between Schiphol and the rest of the African continent between 1993 and 2000, the growth rate appears to slow down slightly in the rest of Africa after the most liberal agreement in May 1997. In addition, there was a drop in the number of routes between Schiphol and the rest of Africa after the 1997 liberalisation. The results from Figure 14 and Figure 15 suggest that the Netherlands-Kenya liberal aviation policy led to increased passenger traffic between the two countries.

Figure 15

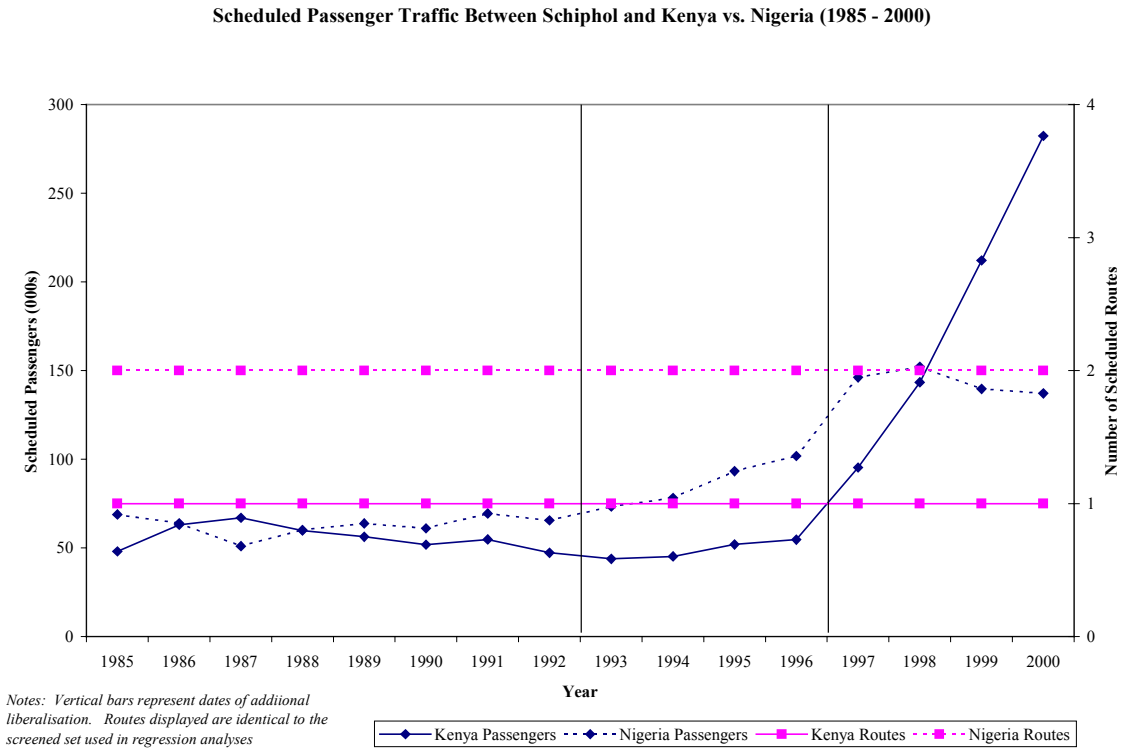


Note: Vertical bars represent dates of additional liberalisation.

We also compared passenger volumes between the Netherlands and Kenya with those between the Netherlands and Nigeria. Since Nigeria has a restrictive aviation policy with the Netherlands, this provides another means of assessing the benefits of liberalisation. Figure 16 shows the passenger traffic between these African countries and the Netherlands. As the graph indicates, the 1997 liberalisation between Kenya and the Netherlands was associated with a sustained increase in the growth rate of passenger traffic between the two countries. By contrast, passenger volumes between the Netherlands and Nigeria increased markedly between 1996 and 1997, and then decreased after that. This decrease could indicate that Kenya was taking away some of the passenger traffic that would have previously travelled to or through Nigeria. Nonetheless, the combined passenger volumes between the Netherlands and these two African counties increased substantially after 1997, suggesting that any diversion of passenger traffic would be quite modest in size.[21]

[21] However, it is worth noting that the number of negative transfer passengers through Nairobi to the rest of Africa increased substantially after 1997 agreement was signed. This is one indication that there were more passengers travelling through Nairobi as transfer passengers. However, we were not able to determine with precision whether the increases in the passengers transferring corresponded to decreases in the numbers of passengers flying non-stop to the other African destinations.

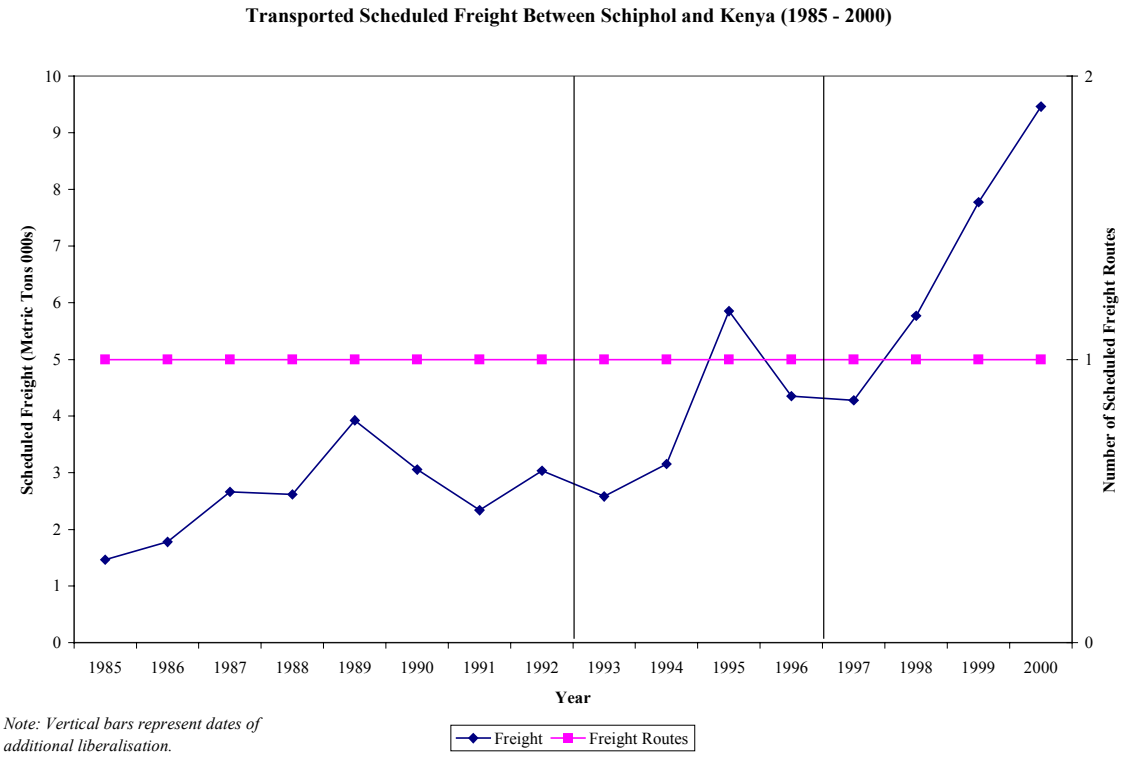
Figure 16



Freight Volumes and Routes

Figure 17 shows the evolution of freight traffic between Schiphol and Nairobi. Again, there was an increase in the growth rate of freight volumes after 1993 compared to the period when the ASA was in effect, but there was a marked increase in freight volumes after the liberalisation in 1997. Freight volumes more than doubled between 1996 and 2000.

Figure 17



Note: Vertical bars represent dates of additional liberalisation.

The pattern of freight volumes described above can be compared to the results for the rest of the continent to see if the growth rate of Netherlands-Kenya freight traffic was merely indicative of general volume increases between Schiphol and the rest of Africa. As shown in Figure 18, the Kenyan patterns are not replicated in the rest of the continent. Freight to the rest of the continent appears to have been increasing in the early 1990s, but it has been decreasing since the Netherlands-Kenya liberalisation in 1997.

Figure 18

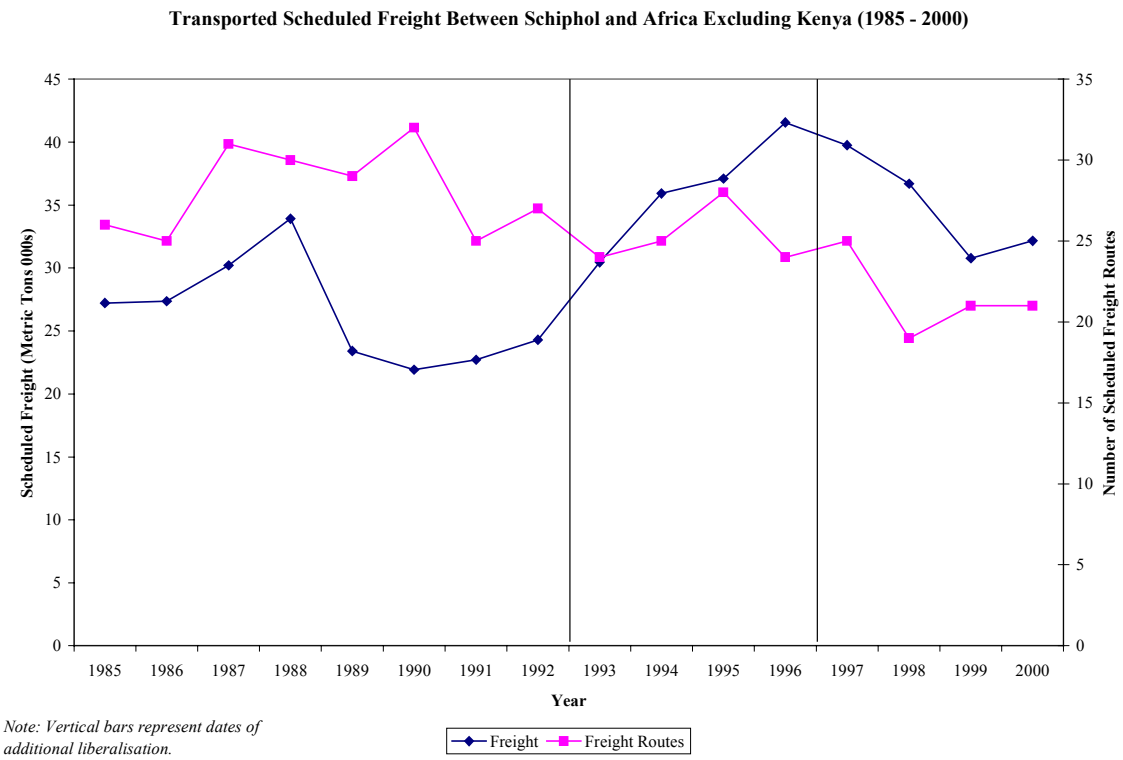
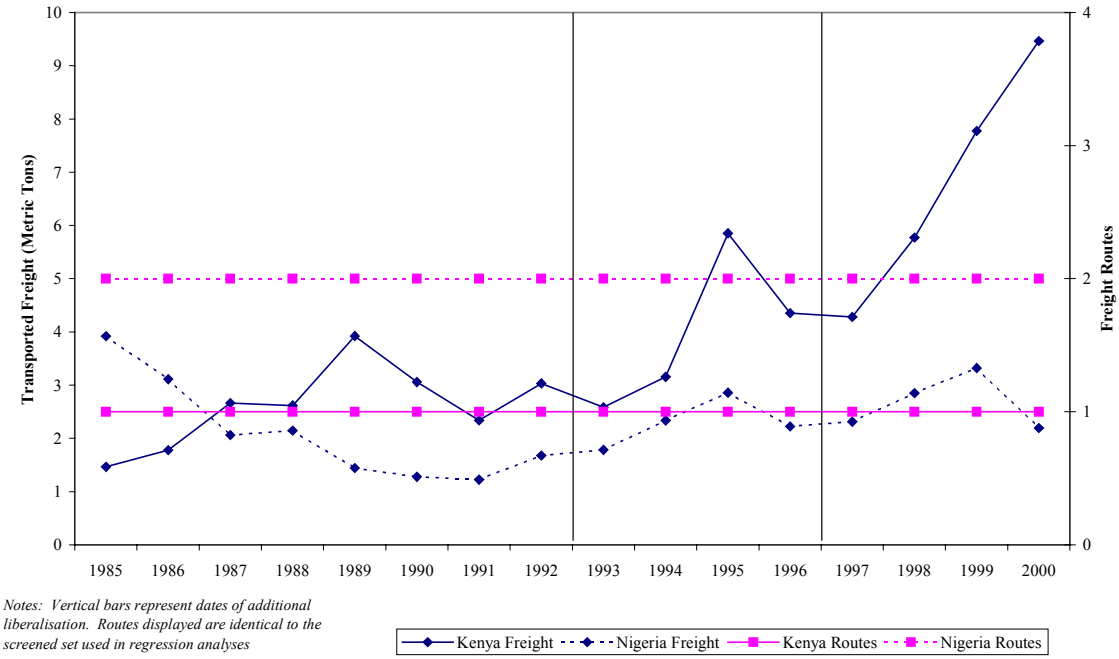


Figure 17 and Figure 18 raise the question of whether liberalisation of bilateral aviation agreements regarding freight may lead to significant diversion of freight traffic from one country to another. Our data on freight volumes are unable to distinguish the ultimate origination or destination point for freight, as the data only track volumes on flights between Schiphol airport and individual African countries. The data cannot determine whether the freight is transferred onto other flights once it reaches the African continent (or reaches other countries through alternate modes of transport).

We also compared Netherlands-Kenya freight volumes with Netherlands-Nigeria freight volumes, since Nigeria has a restrictive aviation policy with the Netherlands. Figure 19 shows that, subsequent to the major aviation liberalisation in 1997, there was a large increase in freight traffic between the Netherlands and Kenya. By contrast, freight volumes between the Netherlands and Nigeria were virtually unchanged between 1996 and 2000.

Figure 19

Transported Scheduled Freight Between Schiphol and Kenya vs. Nigeria (1985 - 2000)



Notes: Vertical bars represent dates of additional liberalisation. Routes displayed are identical to the screened set used in regression analyses

Conclusions from Simple Comparisons: Passenger and Freight Volumes and Routes

The above evidence suggests both passenger and freight volumes between the Netherlands and Kenya increased significantly subsequent to the liberalisation of 1997.

The growth rate of Dutch passenger traffic with Kenya far exceeded the growth rate of Dutch passenger traffic with the rest of the Africa, although the growth rate for the rest of Africa was only slightly diminished after 1997. Therefore, Kenya liberalisation is associated with an increase in the growth rate of passenger volumes between Schiphol and Africa as a whole.[22] In this respect, liberalisation with Kenya did not appear to induce substantive diversion of passengers flying between Schiphol and other African countries, although the number of passengers transferring through Nairobi to the rest of Africa did increase dramatically after the 1997 agreement.

On the other hand, freight volumes between Schiphol and Kenya more than doubled after the 1997 liberalisation, while volumes with the rest of Africa declined. Although other economic factors may have accounted for this decline, some freight traffic may have been diverted from other African entry points to Kenya. The network economies of freight transportation necessitate the use of large hub-and-spoke operations to reduce costs. The value of hub-and-spoke operations for freight traffic may be even greater than for passenger traffic, since users of freight transportation services are largely insensitive

[22] It is likely the co-operative agreement between KLM and Kenya Airways also had a positive impact on the growth of passenger traffic between the two countries.

to the route taken by the freight to reach its ultimate destination. Consequently, Dutch liberalisation with Kenya may have caused Kenya to function in an increased role as a hub for freight transportation to all of Africa.

Regression Analysis: In-Sample Estimation

We used regression techniques to estimate the impact of aviation liberalisation on passenger volumes between the Netherlands and Kenya, controlling for the effects of changes in cost and demand factors. Indicator variables were added to the regression specification to capture the impact of the 1993 and 1997 liberalisations on passenger volumes, exclusive of supply and demand effects.

In this case, we estimate the relationship over the data both before and after the liberalisation occurred. The indicator variables represent estimates of the increase (or decrease) in passenger volumes attributable to liberalisation. This analysis is not predictive in nature; instead, it is designed to isolate the proportion of the actual volume increase (or decrease) that can be attributed to liberalisation as opposed to other economic factors.

Our data set included routes between Schiphol and Kenya and Schiphol and Nigeria. As with our approach to evaluating the impact of the Open Skies agreement with the United States, we used data on routes involving other countries that had not liberalised their aviation policies with the Netherlands. These data were used as a means of improving the reliability of our coefficient estimates describing the relationship between changes in cost and demand factors and changes in passenger volumes. This improves our ability to separate the impact of liberalisation from other economic factors. For demand factors, we used the Netherlands' real GDP and the foreign country's real GDP (in Dutch currency), while cost factors included the real exchange rate and the jet fuel portion of the ATA Cost Index for airlines.

Results

The coefficient estimates for our indicator variables, expressing the impact of changes in the aviation agreement between the Netherlands and Kenya, are presented in Table 9. They are consistent with a 24 percent decline in passenger volumes subsequent to the August 1993 liberalisation, and an incremental increase in passenger volumes of 157 percent subsequent to the May 1997 agreement.

It is unusual that aviation liberalisation by itself would lead to a decline in passenger volumes. Hence, other unidentified economic factors may explain the decline in passenger volumes associated with the 1993 liberalisation. Without taking into account the influence of cost and demand changes, the evidence indicates that passenger volumes between the Netherlands and Kenya were flat during the 1993-96 period (see Figure 14).

In this context, it might make sense to assess the combined impact of both liberalisation agreements based on our regression analysis. Taken together, the two agreements are associated with a statistically significant increase of 96.4 percent in passenger volumes between the Netherlands and Kenya. Thus, aviation liberalisation with

Kenya was associated with a near doubling of passenger volumes according to this analysis.

Table 9

Estimated Impact on Netherlands to Kenya Scheduled Passenger Volume Due to Liberalisation of Bilateral Agreements

Date of Liberalisation Milestone	*Percent Change in Passenger Volume Between the Netherlands and Kenya*
3rd Quarter, 1993	-23.6%
2nd Quarter, 1997	157.1%

Notes and Sources:
Schiphol Counts data.
Model controls for the following variables:
Route, Quarter, NL GDP, Fuel Portion of ATA Index, Foreign CPI, Foreign GDP.
All values except fuel portions of ATA index in real 2000 Q4 Dutch Guilders, with Dutch PPI as inflation rate.
From 1999 - 2000, the official fixed euro conversion rate of 2.20371 Guilders / Euro is used.
Netherlands-Nigeria routes are included in the model for calibration purposes.

Conclusions

Using simple comparisons and regression methods, we find that passenger traffic between the Netherlands and Kenya benefited substantially from aviation liberalisation. In particular, the 1997 agreement was associated with a profound increase in passenger volumes. Our simple comparisons suggest that this increase was not the result of diverting passengers that previously had travelled from or to other African destinations, though there were more passengers transferring through Nairobi to the rest of Africa. Instead, it represents a substantial addition of new passenger traffic between the Netherlands and Africa. The simple comparisons also indicate that liberalisation led to increases in freight traffic between the Netherlands and Kenya, though some of this increase may have been diverted from other African countries.

5.B MALAYSIA

Description of Previous and Present Aviation Agreements with the Netherlands

The Netherlands has signed a series of aviation agreements with Malaysia over the past four decades. In April 1964, the first ASA was signed covering multiple routes from the Netherlands through various connecting points to Kuala Lumpur and Singapore and beyond. In December 1966, another ASA was signed that changed some of the intermediate points and converted Singapore to a point beyond Malaysia and allowed for one flight a week. Then, in December 1979, an agreement was signed changing some of the routes.

More recently, an agreement was signed in October 1987 that increased flight frequencies beginning in April 1988. There were a few further modifications to the routes included. In October 1991, a third agreement was signed increasing the number of flights starting in April 1992 and altering the routes slightly. Finally, in September 1995, a final liberalisation occurred that increased the number of frequencies for passenger traffic and vastly liberalised the protocol for freight traffic beginning in the summer of 1996.

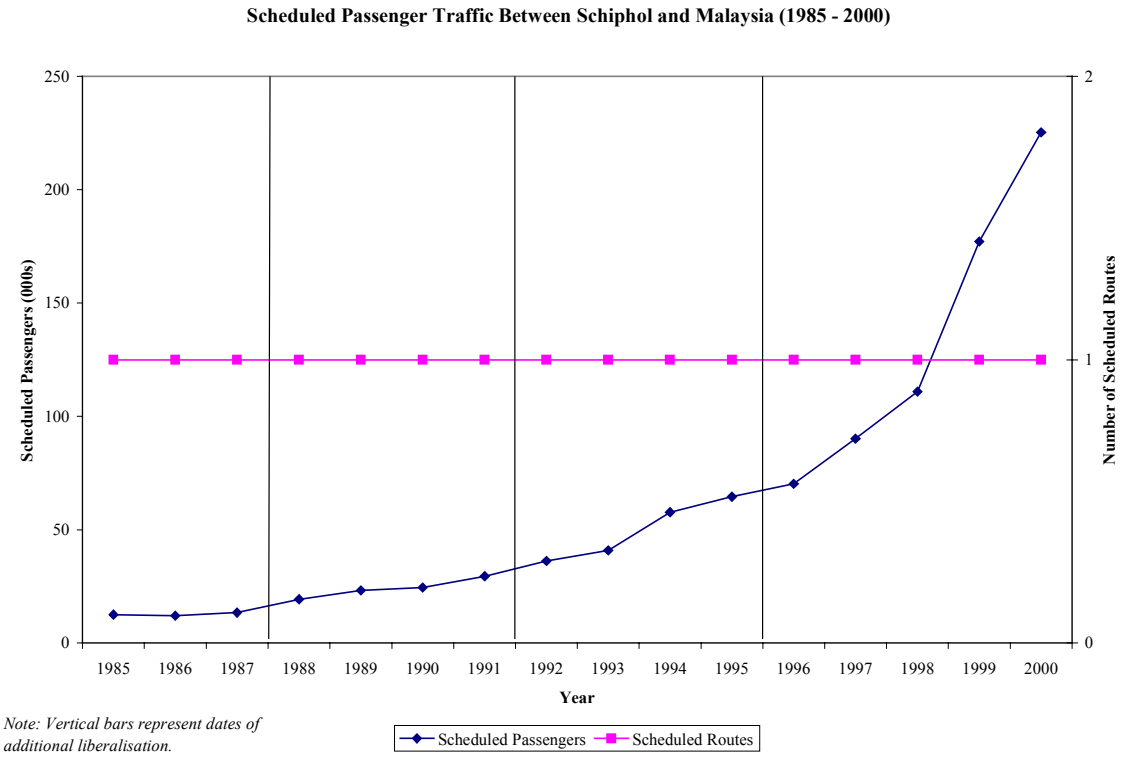
Simple Comparisons

Passenger Volumes and Routes

Figure 20 shows the pattern of passenger traffic between Schiphol and Kuala Lumpur. Passenger volumes increased somewhat after 1988, when the second agreement went into effect. The absolute increase in passengers per year also accelerated after the liberalisation in 1992, and substantial growth occurred in 1994 (after the liberalisation was fully implemented). Passenger volumes rose at an even faster rate beginning in 1997 when the final agreement was in effect. As a result, passenger volumes between the Netherlands and Malaysia more than tripled between 1996 and 2000.

Note that some delay typically occurred before increases in passenger volumes were observed after a new liberalising agreement became effective. For example, although the last agreement became effective in 1996, large increases in passenger traffic did not arise until 1997. Moreover, passenger volumes showed a much larger increase in 1994 than in 1992 or 1993.

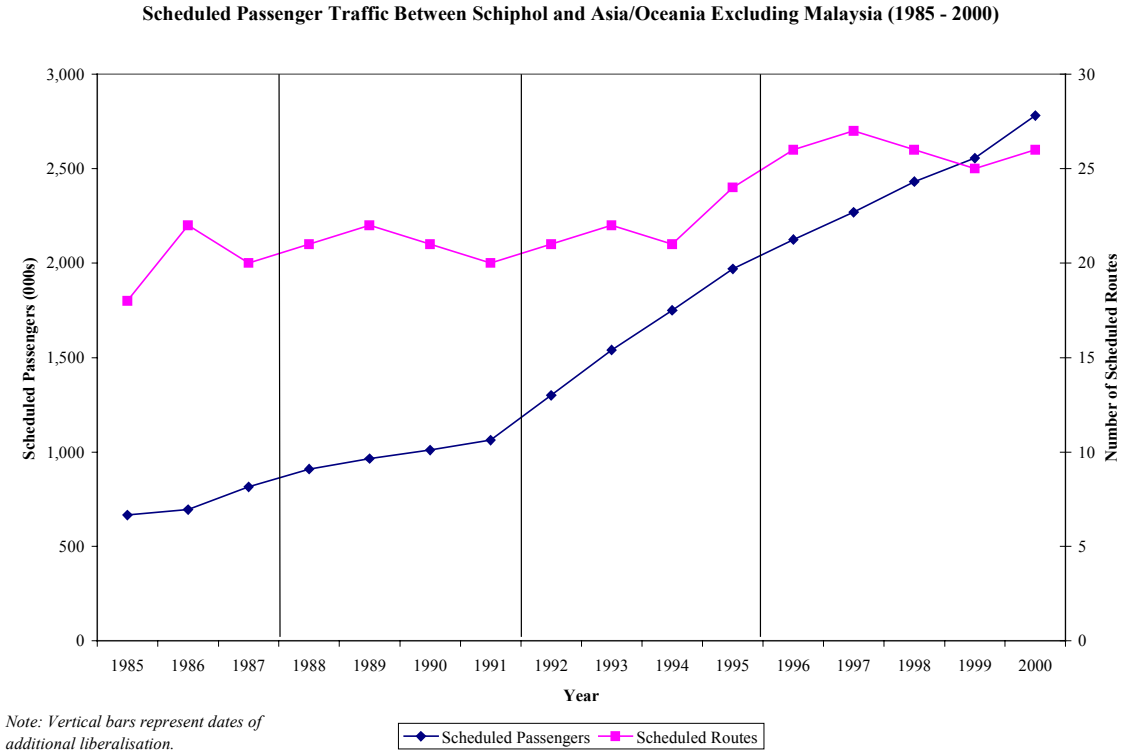
Figure 20



Note: Vertical bars represent dates of additional liberalisation.

To provide a basis of comparison for the Netherlands-Malaysia results, we also examined the pattern of passenger traffic between the Netherlands and the rest of Asia (including Oceania). Figure 21 shows that there was a relatively steady increase in passenger volumes between Schiphol and the rest of Asia over this time period. The growth rate for Netherlands-Malaysia passenger traffic over the 1996-2000 period far exceeded the growth of passenger traffic between the Netherlands and the rest of Asia. This suggests that the increase in passenger volumes between Schiphol and Malaysia over this period may be a result of liberalisation, rather than general trends in passenger traffic between the Netherlands and Asia.

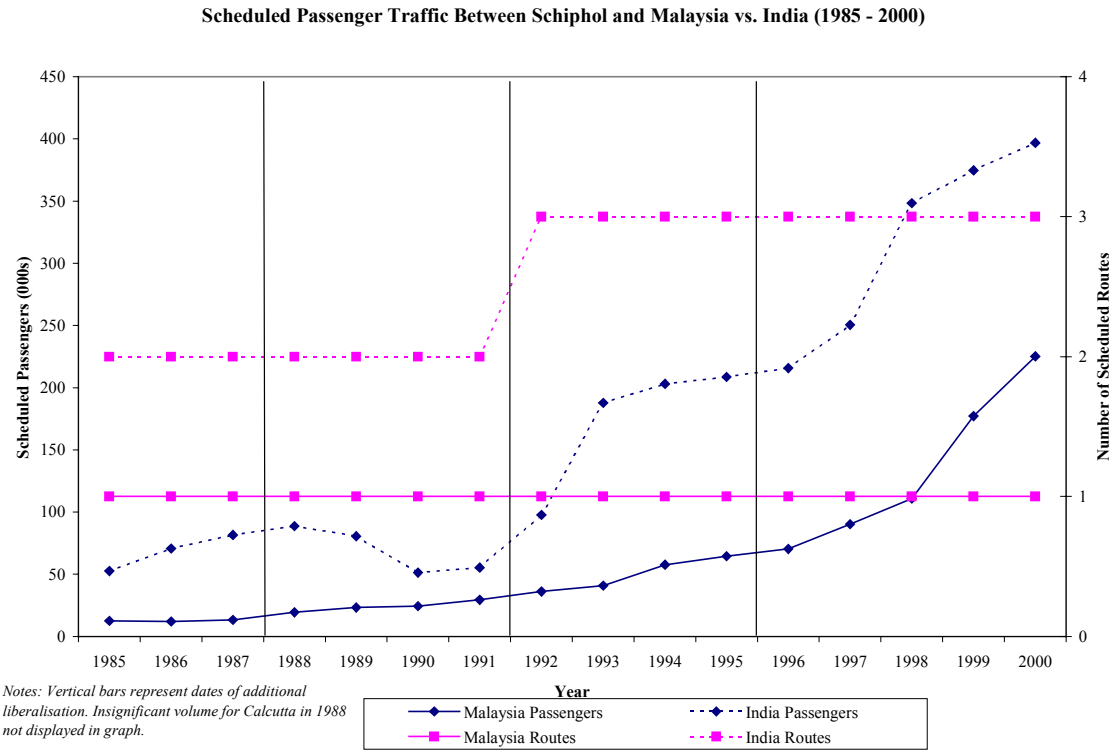
Figure 21



Note: Vertical bars represent dates of additional liberalisation.

Similar to our analysis of Kenya's liberalisation, we compared Malaysia's liberalisation experience with a country that had more restrictive aviation policies with the Netherlands. In this case, India was used as a basis of comparison. From Figure 22, it appears that the growth rate of passenger volumes between the Netherlands and India has been similar to that between the Netherlands and Malaysia over the period from 1991 to 2000. However, after the final liberalisation in 1996, the growth rate of Netherlands-Malaysia passenger volumes exceeded the growth of Netherlands-India passenger volumes in percentage terms.

Figure 22

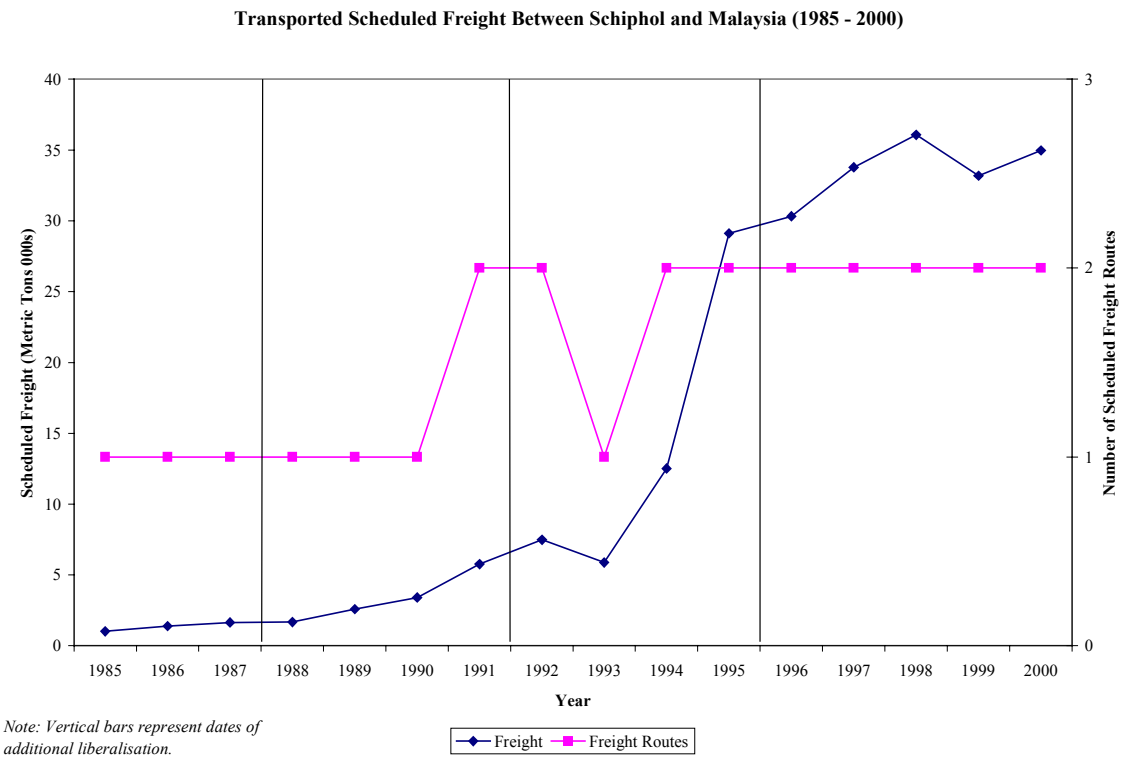


Freight Volumes and Routes

Figure 23 shows the evolution of freight volumes between Schiphol and Kuala Lumpur for the 1985-2000 period. As can be seen, the liberalisation that took effect in April 1992 led to an increase in freight volumes between the two countries in 1992.[23] In addition, freight volumes more than doubled between 1994 and 1995. The final agreement was signed in September 1995, vastly liberalising freight transport between the two countries. Freight volumes at the end of the 1990s were more than eight times their level at the beginning of the decade.

[23] It is a bit puzzling that both the volume of freight and the number of routes apparently increased in 1991, before the agreement became effective.

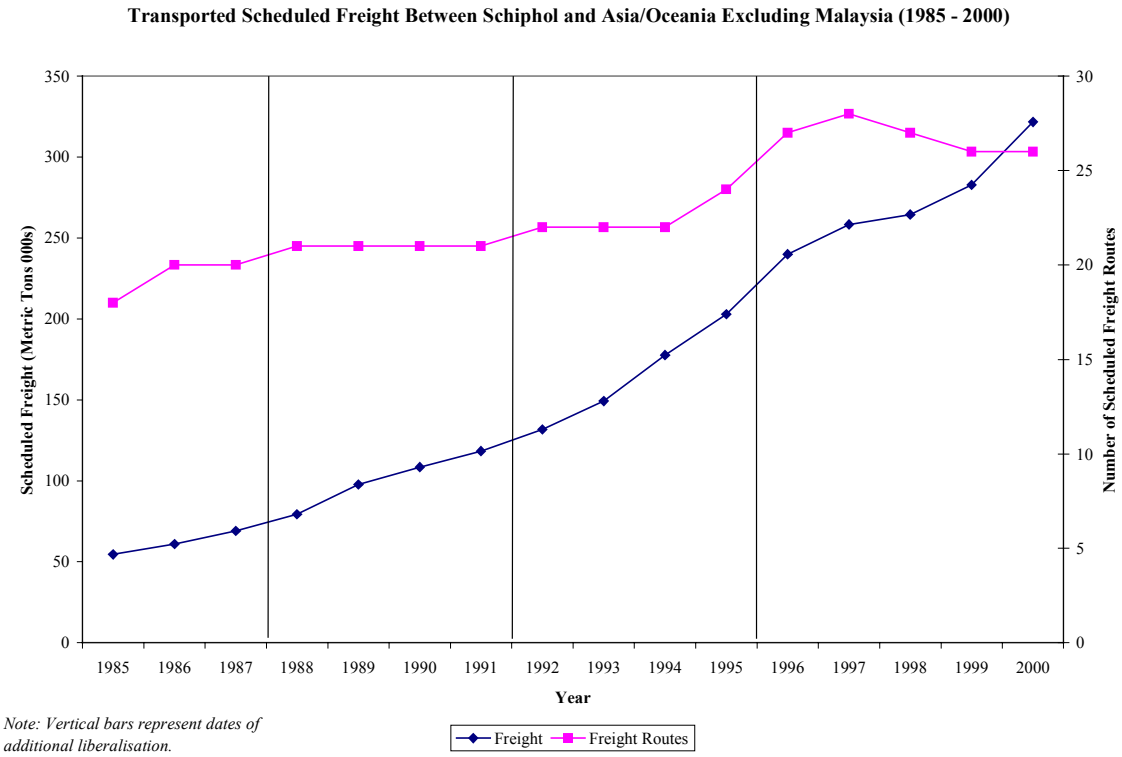
Figure 23



Note: Vertical bars represent dates of additional liberalisation.

Once again, we compare the Malaysia volume patterns with the results for the rest of Asia. As indicated in Figure 24, a steady increase in freight volumes occurred between Schiphol and the rest of Asia over this time period. However, the growth rate in freight volumes since 1994 has been greater between the Netherlands and Malaysia than between the Netherlands and the rest of Asia. This suggests that the increases in freight volumes between Schiphol and Malaysia may be attributable to liberalisation, rather than general trends in freight traffic between the Netherlands and Asia.

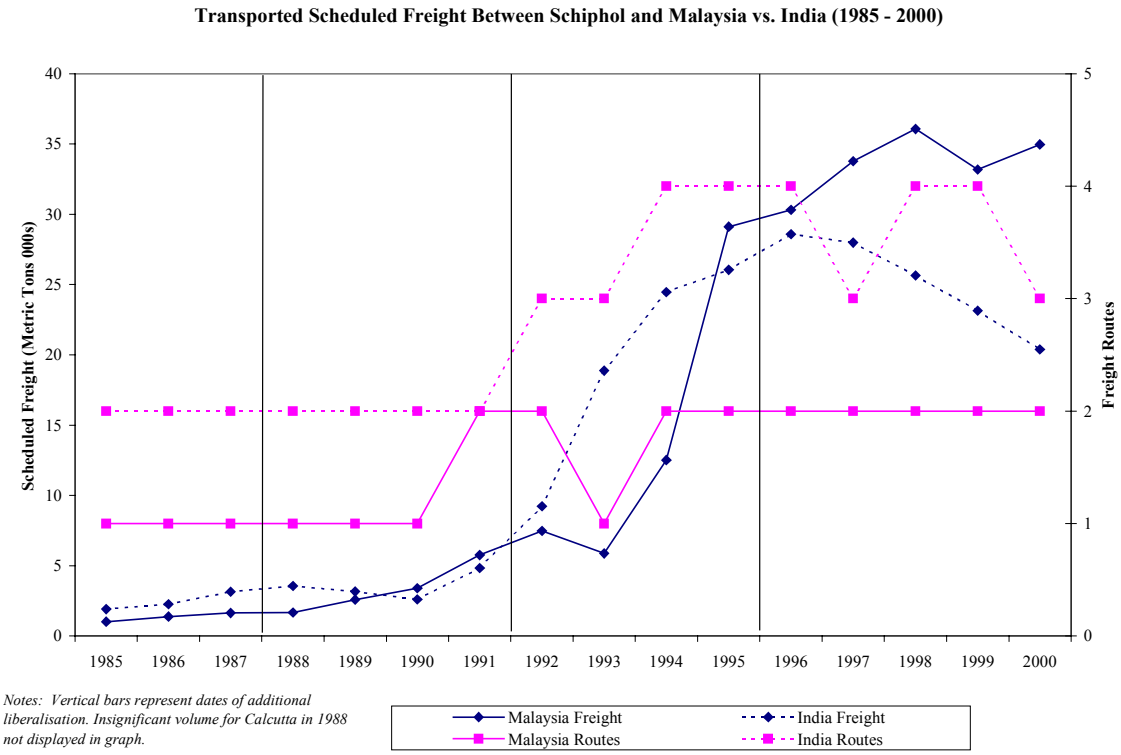
Figure 24



Note: Vertical bars represent dates of additional liberalisation.

Our comparison of freight volumes between the Netherlands and Malaysia with the volumes between the Netherlands and India shows substantially different patterns after the final liberalisation in 1995. As shown in Figure 25, freight volumes rose for Netherlands-Malaysia traffic while the volumes fell for Netherlands-India over the 1995-2000 period. These results are consistent with a positive benefit from the more liberal air transport policy between the Netherlands and Malaysia.

Figure 25



Conclusions from Simple Comparisons: Passenger and Freight Volumes and Routes

The above evidence suggests both passenger and freight volumes between the Netherlands and Malaysia increased under liberalisation, particularly after the latest agreement was signed in September 1995.

Our results show that the growth rate of passenger traffic between the Netherlands and Malaysia was greater than the growth rate of passenger traffic between the Netherlands and the rest of the Asia after 1991.[24] During this period, two distinct aviation liberalisation agreements became effective between the Netherlands and Malaysia. In general, the growth rate of Dutch aviation traffic with Asia increased over the post-1991 period. In this respect, liberalisation with Malaysia did not appear to induce substantive diversion of passengers flying between Schiphol and other Asian countries.[25]

Freight volumes between Schiphol and Malaysia almost tripled between 1994 and 2000, implying that there may have been a substantial volume impact from liberalisation

[24] It is likely the co-operative agreement between KLM and Malaysia Airlines also had a positive impact on the growth of passenger traffic between the two countries.

[25] As was the case with Kenya, it is worth noting that the number of negative transfer passengers through Kuala Lumpur to the rest of Asia increased substantially after 1996 agreement was signed. This is one indication that there were more passengers travelling through Malaysia as transfer passengers. However, we were not able to determine with precision whether the increases in the passengers transferring corresponded to decreases in the numbers of passengers flying non-stop to the other Asian destinations.

under the 1995 agreement. Since freight volumes between the Netherlands and the rest of Asia increased at a relatively steady rate over our entire observation period, it is doubtful that liberalisation with Malaysia led to substantial diversion of freight from other Asian entry points.

Regression Analysis: In-Sample Estimation

We also used regression techniques to estimate the impact of aviation liberalisation on passenger traffic volumes between the Netherlands and Malaysia, controlling for the effects of changes in cost and demand factors. Indicator variables were added to the regression specification to capture the impact of the 1992 and 1996 liberalisations on passenger volumes, exclusive of supply and demand effects.

Our data set included routes between Schiphol and Malaysia and Schiphol and India. As with our previous approaches to evaluating the impact of aviation liberalisation, we used data on routes involving other countries that had not liberalised their aviation policies with the Netherlands. These data were used as a means of improving the reliability of our coefficient estimates describing the relationship between changes in cost and demand factors and changes in passenger volumes. This improves our ability to separate the impact of liberalisation from other economic factors. For demand factors, we used the Netherlands' real GDP and the foreign country's real GDP (in Dutch currency), while cost factors included the real exchange rate and the jet fuel portion of the ATA Cost Index for airlines.

Results

The coefficient estimates for our indicator variables, expressing the impact of changes in the aviation agreement between the Netherlands and Malaysia are presented in Table 10. They are consistent with a nearly 20 percent increase in passenger volumes associated with the liberalisation that went into effect in April 1992, and a 36 percent increase associated with the agreement that went into effect in 1996. Combined, the increase in passenger volumes associated with both liberalisation agreements is 63 percent.

Table 10

Estimated Impact on Netherlands to Malaysia Scheduled Passenger Volume Due to Liberalisation of Bilateral Agreements

Date of Liberalisation Milestone	*Percent Change in Passenger Volume Between the Netherlands and Malaysia*
2nd Quarter, 1992	19.8%
2nd Quarter, 1996	36.4%

Notes and Sources:
Schiphol Counts data.
Model controls for the following variables:
Route, Quarter, NL GDP, Fuel Portion of ATA Index, Foreign CPI, Foreign GDP.
All values except fuel portions of ATA index in real 2000 Q4 Dutch Guilders, with Dutch PPI as inflation rate.
From 1999 - 2000, the official fixed euro conversion rate of 2.20371 Guilders / Euro is used.
Netherlands-India routes are included in the model for calibration purposes.

Conclusions

Using simple comparisons and regression methods, we find that passenger traffic between the Netherlands and Malaysia benefited substantially from aviation liberalisation. In particular, the combined impact of the 1991 liberalisation (that went into effect in 1992) and the 1995 agreement (that went into effect in the summer of 1996) was to raise passenger volumes by 63 percent. Our simple comparisons suggest that it is unlikely that this increase can be attributed to the diversion of passengers previously travelling from or to other Asian destinations, though there were more passengers transferring through Kuala Lumpur to the rest of Asia, especially after the 1995 agreement. The simple comparisons also indicate that liberalisation led to increases in freight traffic between the Netherlands and Malaysia. It is not likely this increase was mainly the result of diversion from the rest of Asia.

5.C BRAZIL

Description of Previous and Present Aviation Agreements with the Netherlands

Brazil is our final case study of countries that have significantly liberalised their aviation policies with the Netherlands. Brazil and the Netherlands signed an ASA in November 1947 covering multiple designations on routes between Amsterdam and Rio de Janeiro with intermediate points. A second ASA was signed in July 1976 with a single designation on routes between the Netherlands and Brazil with intermediate points and points beyond. Then, in June 1988 an interim agreement was signed covering additional services per week and additional usable seats.

Brazil and the Netherlands signed a liberalised agreement in June 1989 that covered certain routes with intermediate points and beyond points. This agreement expanded the seat capacity on flights between the Netherlands and Brazil. In December 1994, a second

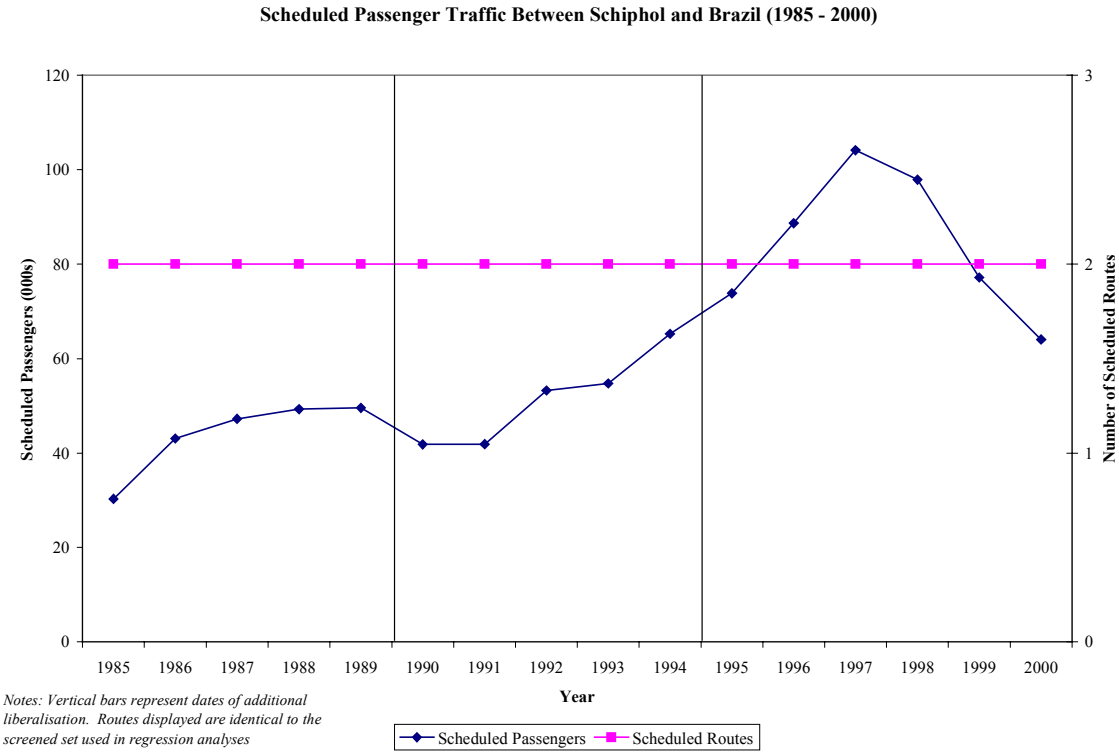
liberalisation increased weekly flight frequencies between the Netherlands and Brazil by the end of 1995 and further modified fifth-freedom rights.

Simple Comparisons

Passenger Volumes and Routes

Figure 26 shows passenger volumes between Schiphol and Brazil.[26] There seems to have been a modest increase after the liberalisation in 1989, with a somewhat greater increase in traffic after the agreement at the end of 1994. Passenger volumes peaked in 1997, but then have fallen as Brazil has encountered significant economic problems in recent years.

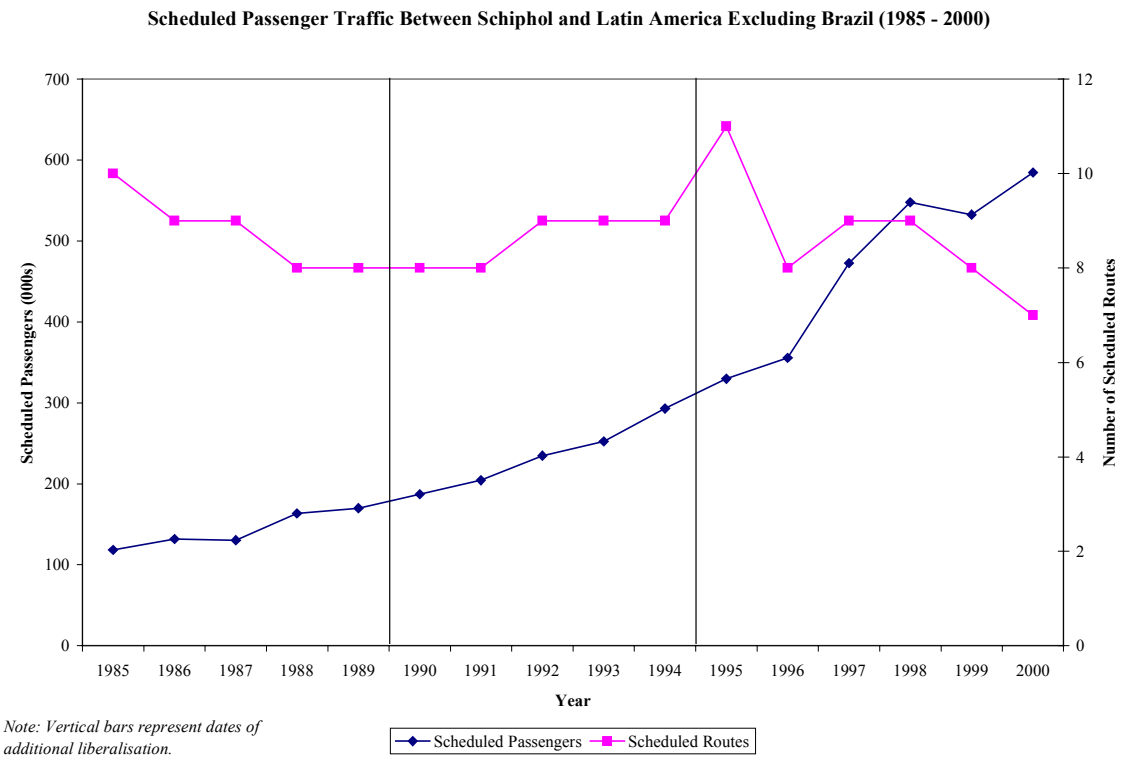
Figure 26



As indicated in Figure 27, passenger volumes between the Netherlands and the rest of Latin America grew at a faster rate than passenger volumes between the Netherlands and Brazil over the 1989-1997 period. In contrast to Brazil, these volumes have continued to rise since 1997.

[26] Routes with small passenger volumes (*i.e.*, fewer than 2,000 passengers per year) have been excluded from our passenger and route totals. These routes appeared sporadically in the data, and were omitted from our analysis due to reliability concerns.

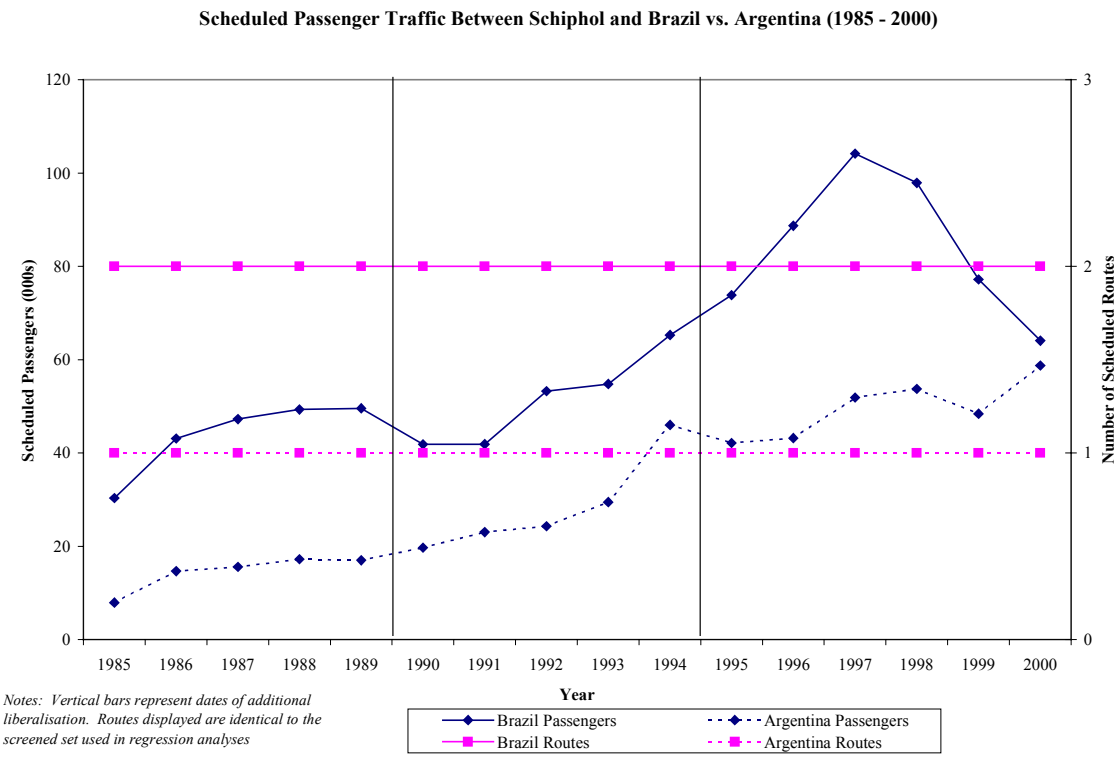
Figure 27



Note: Vertical bars represent dates of additional liberalisation.

We have also compared Brazil to Argentina, a country with a relatively restrictive aviation policy with the Netherlands. As shown in Figure 28, it appears that after the 1994 agreement was completed, passenger volumes between the Netherlands and Brazil increased much more rapidly than passenger volumes between the Netherlands and Argentina. This pattern was reversed after Brazil encountered severe economic problems in the late 1990s.

Figure 28

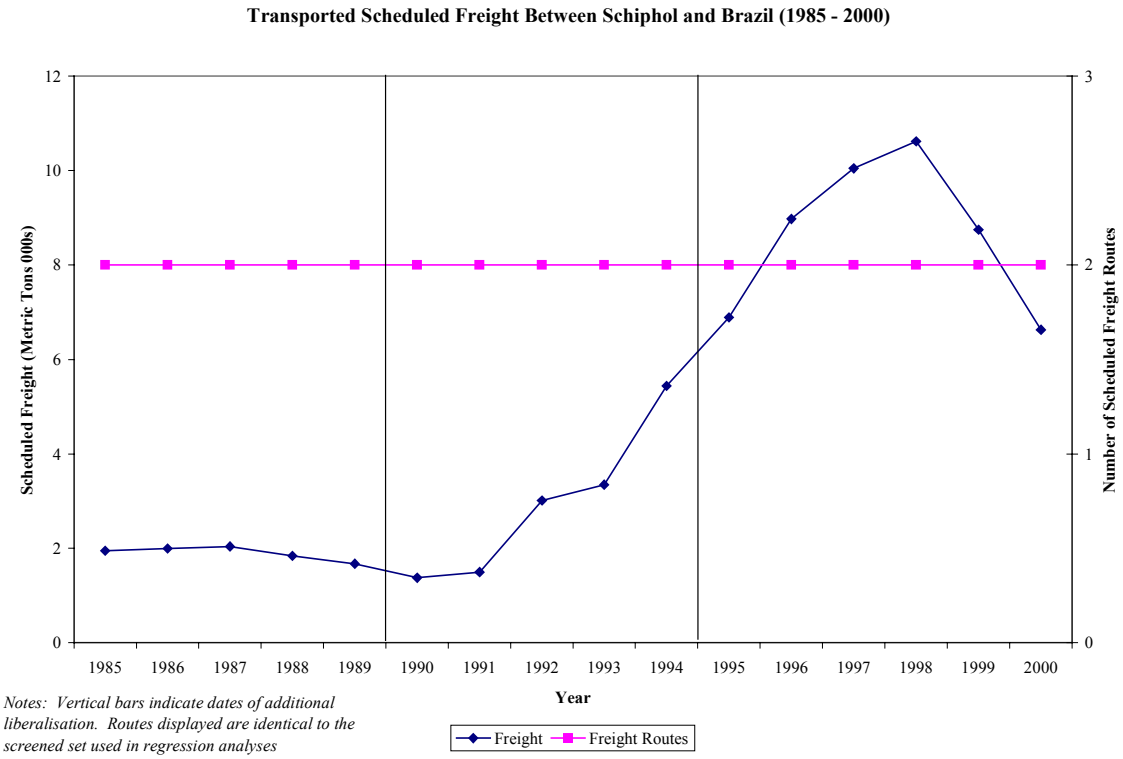


Notes: Vertical bars represent dates of additional liberalisation. Routes displayed are identical to the screened set used in regression analyses

Freight Volumes and Routes

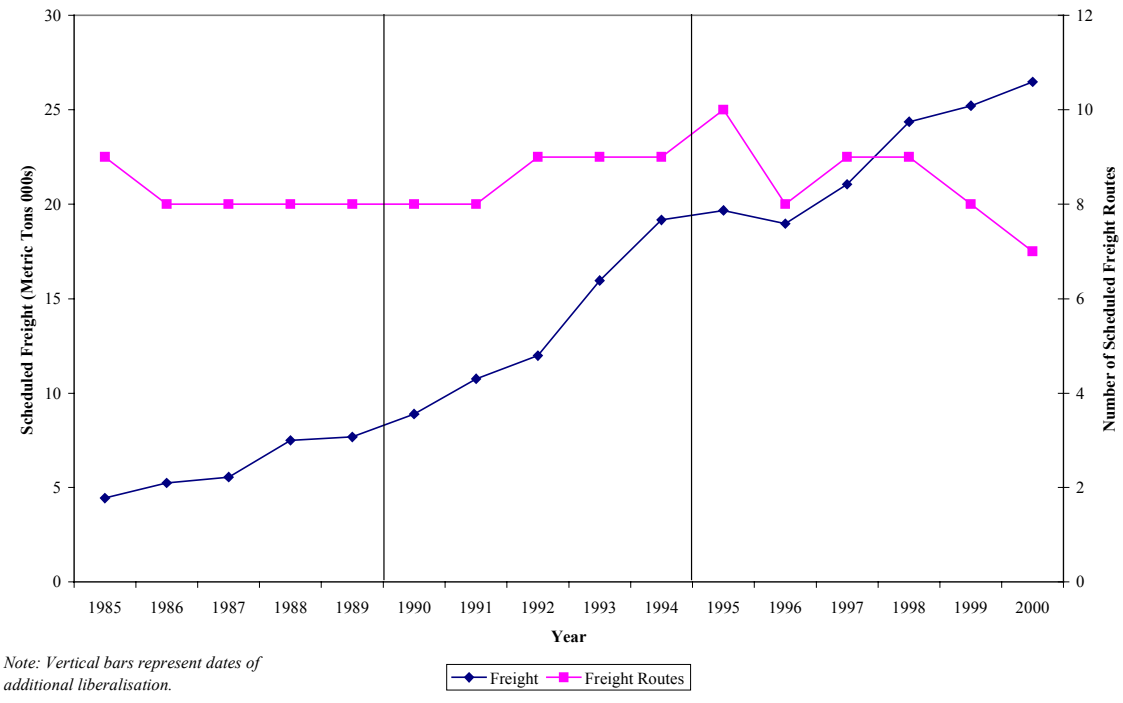
Figure 29 shows the pattern of freight traffic between Schiphol and Brazil. Freight volumes began increasing markedly in 1992 and peaked in 1998. Thus, a simple comparison suggests that freight volumes rose substantially after both liberalisation agreements. Once again, deterioration of Brazil's economy led to a decline in volume after 1998. As described in Figure 30, freight volumes between the Netherlands and the rest of Latin America grew rapidly over the same period, but the growth rate was lower than that of freight traffic with Brazil.

Figure 29



Notes: Vertical bars indicate dates of additional liberalisation. Routes displayed are identical to the screened set used in regression analyses

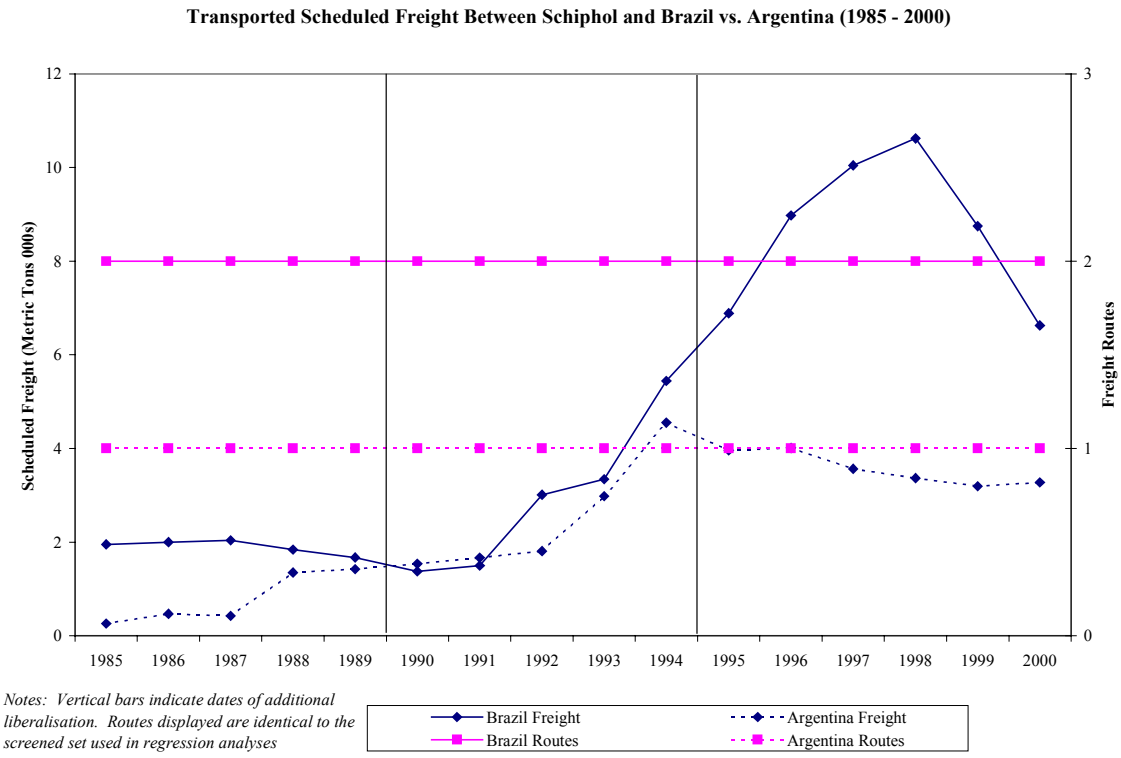
Figure 30



Note: Vertical bars represent dates of additional liberalisation.

The rapid growth of freight volumes after 1994 between Schiphol and Brazil contrasts noticeably with freight volumes between Schiphol and Argentina, which decline after 1994 (as shown in Figure 31). It appears the 1994 agreement stimulated freight activity between the Netherlands and Brazil until Brazil's economic problems induced a decline in demand. However, similar to the experience of freight liberalisation between the Netherlands and Kenya, concern exists that liberalisation between the Netherlands and Brazil may have diverted freight traffic between the Netherlands and other countries in Latin America.

Figure 31



Notes: Vertical bars indicate dates of additional liberalisation. Routes displayed are identical to the screened set used in regression analyses

Conclusions from Simple Comparisons: Passenger and Freight Volumes and Routes

On the surface, it does not appear the liberalisation led to a substantial increase in passenger traffic between the Netherlands and Brazil. Between 1989 and 1994, passenger volumes between the Netherlands and Brazil increased at a slower rate than passenger volumes between the Netherlands and the rest of Latin America. This relatively slow growth occurred in spite of an interim agreement in 1988 and a subsequent liberalisation in June 1989 that substantially expanded seat capacity on flights between the Netherlands and Brazil.

Although the 1994 liberalisation increased flight frequencies between the Netherlands and Brazil, the growth rate over the 1994-1997 period in passenger volumes between the Netherlands and Brazil was roughly comparable to the growth rate between the Netherlands and the rest of Latin America. Passenger volumes between the Netherlands and Brazil increased about 60 percent over this period, but then Brazil's economic

difficulties caused passenger volumes to decline to their 1994 levels by 2000. By contrast, passenger volumes between the Netherlands and the rest of Latin America continued to grow.

In terms of freight volumes, Brazil fared a little worse than the rest of Latin America after the 1989 agreement was signed, but much better after the 1994 agreement (at least until 1998). Overall, between 1989 and 1998, freight volumes between the Netherlands and Brazil grew at a substantially higher rate than freight volumes between the Netherlands and the rest of Latin America. Again, the possibility exists that some freight was diverted from other Latin American countries to Brazil as a result of Brazil's liberalisation. However, the extent of freight diversion does not appear as significant as with aviation liberalisation between the Netherlands and Kenya, where broad liberalisation in 1997 was associated with subsequent increases in freight traffic involving Kenya and decreases involving the rest of Africa. In the case of Brazil's liberalisation, freight volumes between the Netherlands and the rest of Latin America continued to rise after both the 1989 and 1994 liberalisation agreements.

Regression Analysis: In-Sample Estimation

We used regression techniques to estimate the impact of aviation liberalisation on passenger traffic volumes between the Netherlands and Brazil, controlling for the effects of changes in cost and demand factors. Indicator variables were added to the regression specification to capture the impact of the 1989 and 1994 liberalisations on passenger volumes, exclusive of supply and demand effects.

Our data set included routes between Schiphol and Brazil and Schiphol and Argentina. As with our prior approach to evaluating the impact of aviation liberalisation, we used data on routes involving other countries that had not liberalised their aviation policies with the Netherlands. These data were used as a means of improving the reliability of our coefficient estimates describing the relationship between changes in cost and demand factors and changes in passenger volumes. For demand factors, we used the Netherlands' real GDP and the foreign country's real GDP (in Dutch currency), while cost factors included the real exchange rate and the jet fuel portion of the ATA Cost Index for airlines.

Results

The regression results, as shown in Table 11, appear to support the inference from our simple comparisons that aviation liberalisation between the Netherlands and Brazil has not been associated with increased passenger volumes between the two countries.

Table 11

Estimated Impact on Netherlands to Brazil Scheduled Passenger Volume Due to Liberalisation of Bilateral Agreements

Date of Liberalisation Milestone	*Percent Change in Passenger Volume Between the Netherlands and Brazil*
2nd Quarter, 1990	-19.2%
1st Quarter, 1995	-10.0%

Notes and Sources:
Schiphol Counts data.
Model controls for the following variables:
Route, Quarter, NL GDP, Fuel Portion of ATA Index, Foreign CPI, Foreign GDP.
All values except fuel portions of ATA index in real 2000 Q4 Dutch Guilders, with Dutch PPI as inflation rate.
From 1999 - 2000, the official fixed euro conversion rate of 2.20371 Guilders / Euro is used.
Netherlands-Argentina routes are included in the model for calibration purposes.

Two points are worth noting. First, the liberalisation agreements between the Netherlands and Brazil did not go as far as the agreements with Kenya and Malaysia in terms of creating an open, liberalised air policy. Since the agreements with Brazil were not as liberal as those with the other two countries, we would not expect the impact of the agreements with Brazil to be as pronounced as they were with Kenya and Malaysia.

Second, it appears that part of the reason we are estimating negative impacts of liberalisation with Brazil is due to the lack of growth of passenger traffic between Schiphol and Rio de Janeiro. When we exclude Rio from the regression model, the estimated impact of each of the two agreements in the 1990s is positive. The traffic with Rio did not grow as fast as the regression predicted it should have after the liberalisation agreements were signed, so the model assigned that lack of growth to the agreement indicator variables. We do not believe this means that the liberalisation with Brazil was necessarily positive overall. The Rio de Janeiro route is an important component of Netherlands-Brazil passenger traffic. We believe we were not able to identify all of the factors that influenced the traffic between the Netherlands and Brazil due to the economic and political problems in Brazil during the 1990s.

It is highly doubtful that liberalisation had a negative impact on passenger volumes, as suggested by our regression results. This raises the issue, as mentioned above, whether any regression analysis of the impact of aviation liberalisation with Brazil can readily include sufficient economic data to accurately describe the unsteady performance of the Brazilian economy over the past decade. It is likely that our statistical analysis was unable to fully account for the economic and political problems that have affected demand for air transportation service between Brazil and the Netherlands.

5.D CONCLUSIONS

The data suggest that the Netherlands has benefited from aviation liberalisation agreements that were completed with Kenya and Malaysia. However, the results with respect to aviation liberalisation between the Netherlands and Brazil are decidedly mixed.

With respect to both passengers and freight, the volume of traffic between the Netherlands and Kenya and between the Netherlands and Malaysia generally grew at a higher rate after liberalisation than traffic volumes to other countries in the same region. Thus, aviation liberalisation has exerted a positive impact on passenger and freight volumes involving those countries.

Our analysis also considered the prospect of diversion of passenger and freight traffic as a result of liberalisation with selected countries. With respect to passengers, we find that liberalisation with Kenya and Malaysia is likely associated with regional increases in volume.[27] However, the behaviour of regional freight volumes in Africa after liberalisation with Kenya is consistent with significant freight diversion to Kenya from the rest of Africa. We find this effect is much smaller in the case of the liberalisation with Malaysia.

Consequently, liberalisation with Kenya and Malaysia likely has produced substantial consumer benefits with respect to passenger traffic. As for freight traffic, even though regional freight volumes may not have increased substantially as a result of liberalisation with selected countries, it may well be the case that liberalisation produced improved efficiency and better quality service with respect to transporting freight.

Liberalisation with Brazil, by itself, does not seem to have spurred significant increases in passenger volumes. The 1994 liberalisation may have stimulated freight traffic between the Netherlands and Brazil (until Brazil's recent economic difficulties), but there may have been some diversion of freight that previously travelled between the Netherlands and other locations in Latin America.

[27] As noted above, we found increases in negative transfer passengers through Kenya and Malaysia after the liberalisation agreements were signed.

6. Did the Netherlands Benefit from a First-Mover Advantage?

As discussed above, we were asked to evaluate whether the Netherlands gained an advantage from its forefront position in completing an Open Skies agreement with the United States before other European countries. We have attempted to determine whether Schiphol airport would have been less utilised if the Netherlands had signed its Open Skies agreement with the United States at the same time, or later than, other European countries. We already have presented some evidence suggesting that passenger volumes through Schiphol were higher as a result of the Netherlands "first move" into liberalising its air transport agreement with the United States.

Economic theory would predict that when a country liberalises its international aviation agreement with another country, the addition of new routes and the increased competition on existing routes would produce better service, lower airfares, and increased passenger volumes. A good example is the case of transatlantic travel between Europe and the United States. If the Netherlands liberalised its aviation agreement with the United States before nearby European countries, the increased competition between Dutch and US carriers would lead to lower fares, greater flight frequency, and more routes between Schiphol and the United States. Since the air carriers serving the Netherlands-US market can attract passengers from nearby European countries (or take those passenger from their point of origin to Schiphol and then on to the United States), it is possible that Schiphol could develop more rapidly as a hub for transatlantic and intra-European travel due to these effects of liberalisation. With carriers in other European countries more restricted in their ability to carry passengers to the United States, carriers serving the Netherlands-US market would be in a position to increase their share of EU-US traffic. This is consistent with our above findings, and is confirmed by other findings presented later in this section.

If the Netherlands had liberalised its aviation agreement with the United States after other countries in Europe, one would expect the reverse effects to occur. Carriers in other European countries potentially would offer less expensive fares and more frequent service to the United States relative to Dutch carriers, allowing those carriers to attract more passengers. Consequently, passenger traffic through Schiphol would be diminished in relative terms.

If the Netherlands and the other European countries liberalised at approximately the same time, then economic theory would predict that the increased competition on all transatlantic routes would lead to lower fares and greater traffic flows between the US and Europe. In this case, it is possible that lower fares and improved service would lead to increased transatlantic passenger volumes for many of the liberalising countries.

This section analyses in further detail whether the Netherlands benefited from being the first European country to sign an Open Skies agreement with the United States. We analyse how passenger volumes through Schiphol have increased relative to other European hubs during the Open Skies period.

Also, we generate additional "in sample" predictions of transatlantic passenger volumes using our earlier regression analysis. Based on these "in-sample" predictions and

our earlier "out-of-sample" predictions, the analysis then evaluates how the actual performance of the Netherlands, Belgium, and Germany compares to the predicted performance in the absence of liberalisation during specific periods subsequent to the Netherlands' 1992 Open Skies agreement with the United States. This allows us to evaluate more carefully how the Netherlands "first move" into an Open Skies agreement affected nearby countries that had not yet liberalised, and how transatlantic liberalisation by those nearby countries affected transatlantic aviation traffic to and from the Netherlands.

6.A SCHIPHOL'S PERFORMANCE COMPARED TO OTHER EUROPEAN HUBS

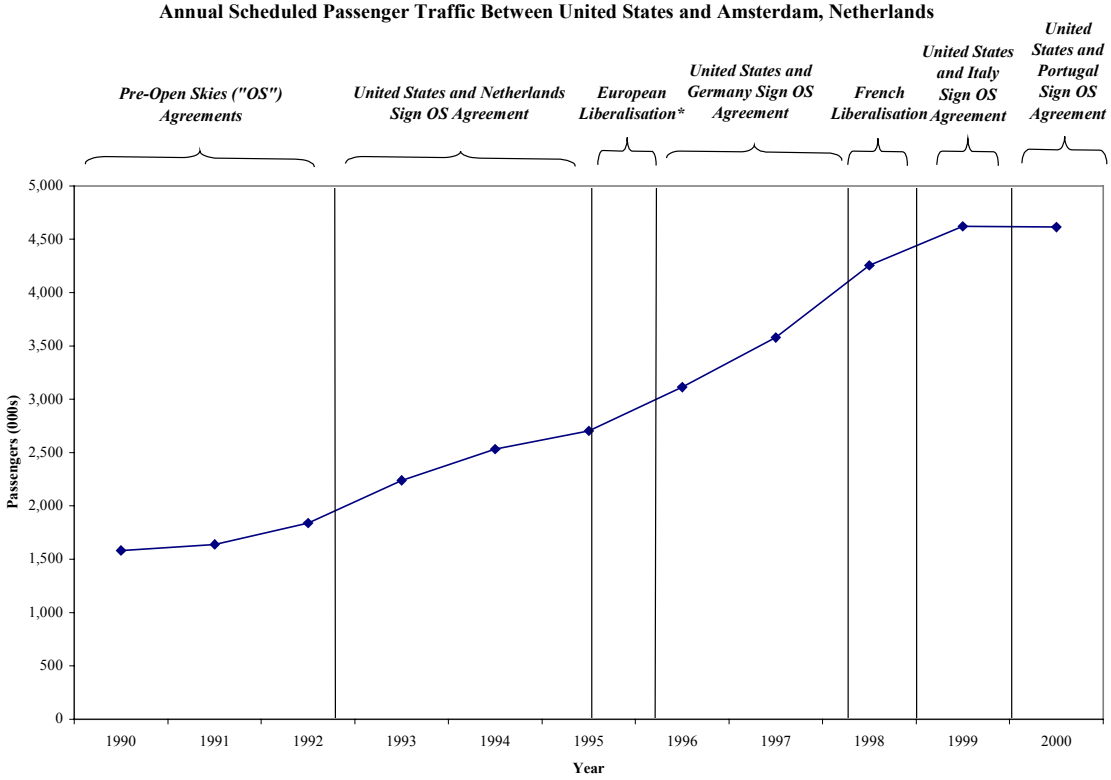
The analysis in Section 4 indicated that passenger volumes through Schiphol to the United States have exhibited the pattern associated with a first-mover advantage. Volumes between 1992 and 1995 grew at a rate higher than in the pre-1992 period. Then, the annual growth rate slowed once other European countries signed Open Skies agreements with the United States.

Further insight can be gained by comparing the transatlantic traffic volumes from Schiphol with other European transatlantic hub cities, such as Brussels, Frankfurt, London, and Paris. Figure 32 through Figure 36 show the annual transatlantic passenger volumes between those five cities (including Amsterdam) and the United States, using data on passenger counts by flight segment from the US Department of Transportation's T-100 International Databank.[28] As can be seen from these figures, the Netherlands experienced a marked increase in transatlantic passenger traffic starting in 1992 and continuing through 2000. None of the other countries currently under an Open Skies agreement with the United States experienced as large an increase in transatlantic passenger volumes from their hub cities over the same period. London experienced larger absolute increases in passenger volumes, but the percentage increase since 1992 was less than half the percentage increase at Schiphol.

Transatlantic passenger volumes between Amsterdam (*i.e.*, Schiphol) and the United States grew by approximately 150 percent from 1992 to 2000, while Brussels transatlantic traffic increased by approximately 130 percent over the same period. By contrast, Frankfurt, London (in a non-Open Skies country), and Paris transatlantic passenger volumes increased by approximately 50 percent, 80 percent, and 60 percent, respectively. These simple comparisons suggest that, of these five major European hubs, Schiphol benefited the most during the period of European aviation liberalisation with the United States. This performance may well be attributable to the Netherlands' "first move" into an Open Skies relationship with the United States.

[28] We compared the T-100 data for passengers travelling between the Netherlands and the United States with the Schiphol Counts data. While the totals did not match exactly, the results were sufficiently close that we believe these data can be used reliably for this purpose.

Figure 32

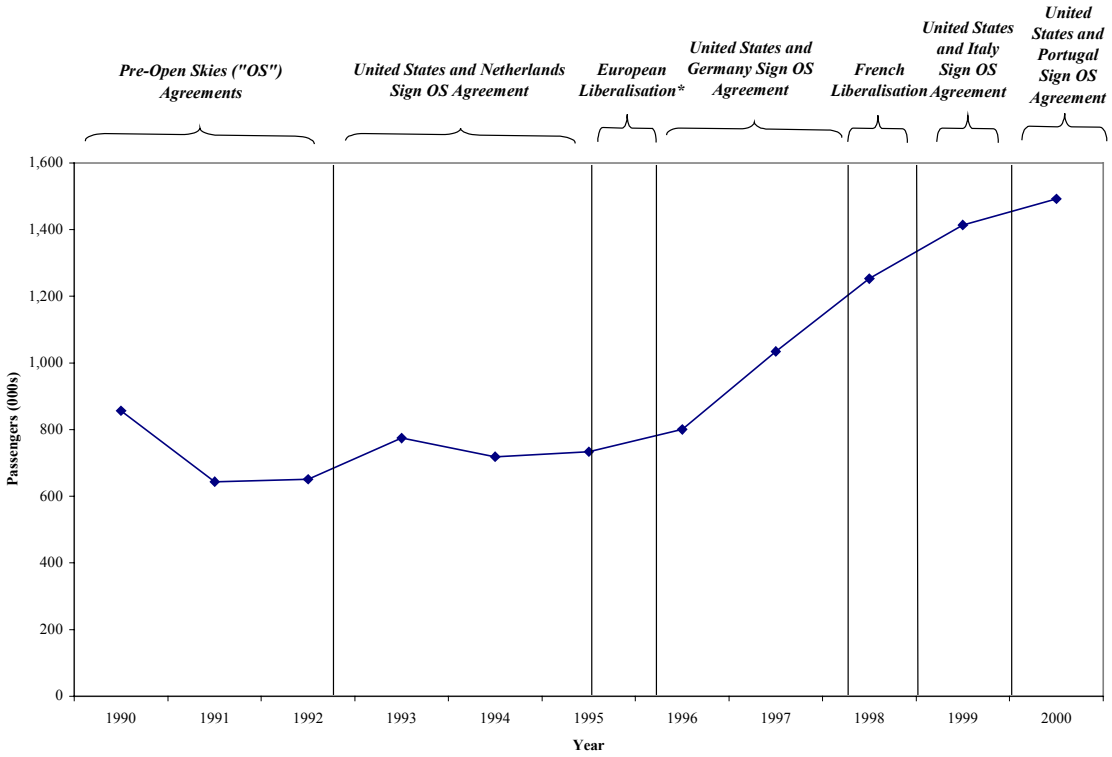


Source: US DOT T-100 International Databank.

** Open Skies Agreements signed between the United States and Austria, Belgium, Denmark, Finland, Iceland, Luxembourg, Norway, Sweden, and Switzerland.*

Figure 33

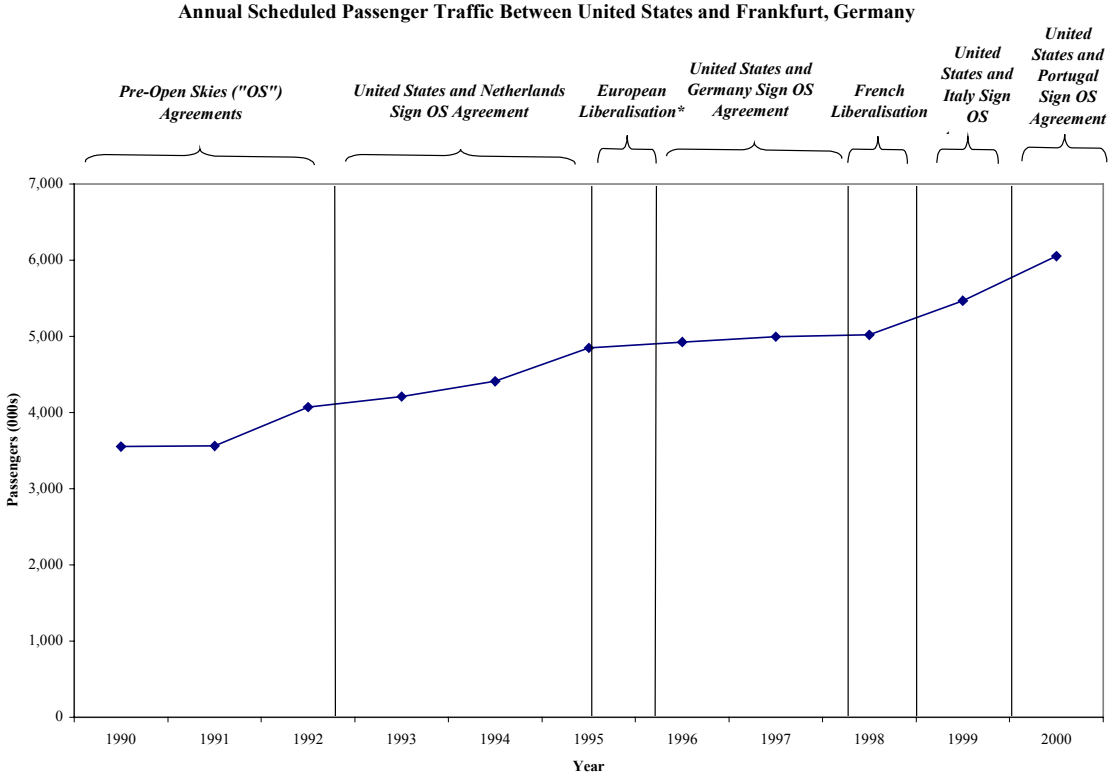
Annual Scheduled Passenger Traffic Between United States and Brussels, Belgium



Source: US DOT T-100 International Databank.

** Open Skies Agreements signed between the United States and Austria, Belgium, Denmark, Finland, Iceland, Luxembourg, Norway, Sweden, and Switzerland.*

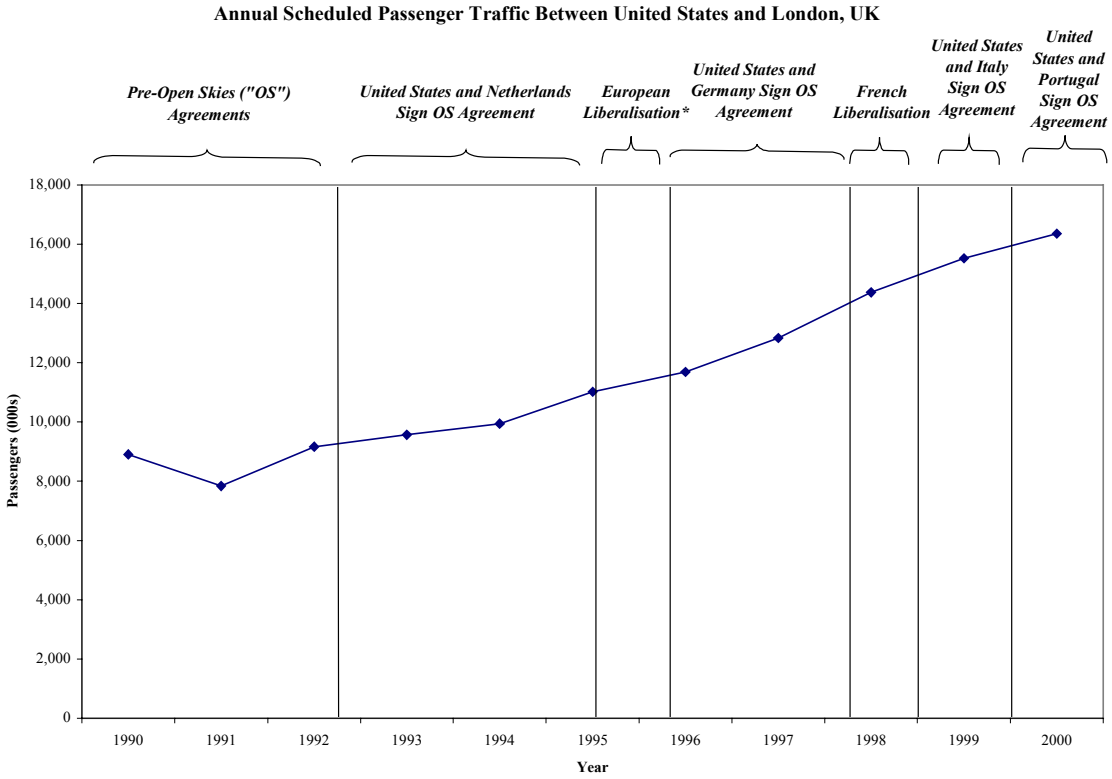
Figure 34



Source: US DOT T-100 International Databank.

** Open Skies Agreements signed between the United States and Austria, Belgium, Denmark, Finland, Iceland, Luxembourg, Norway, Sweden, and Switzerland.*

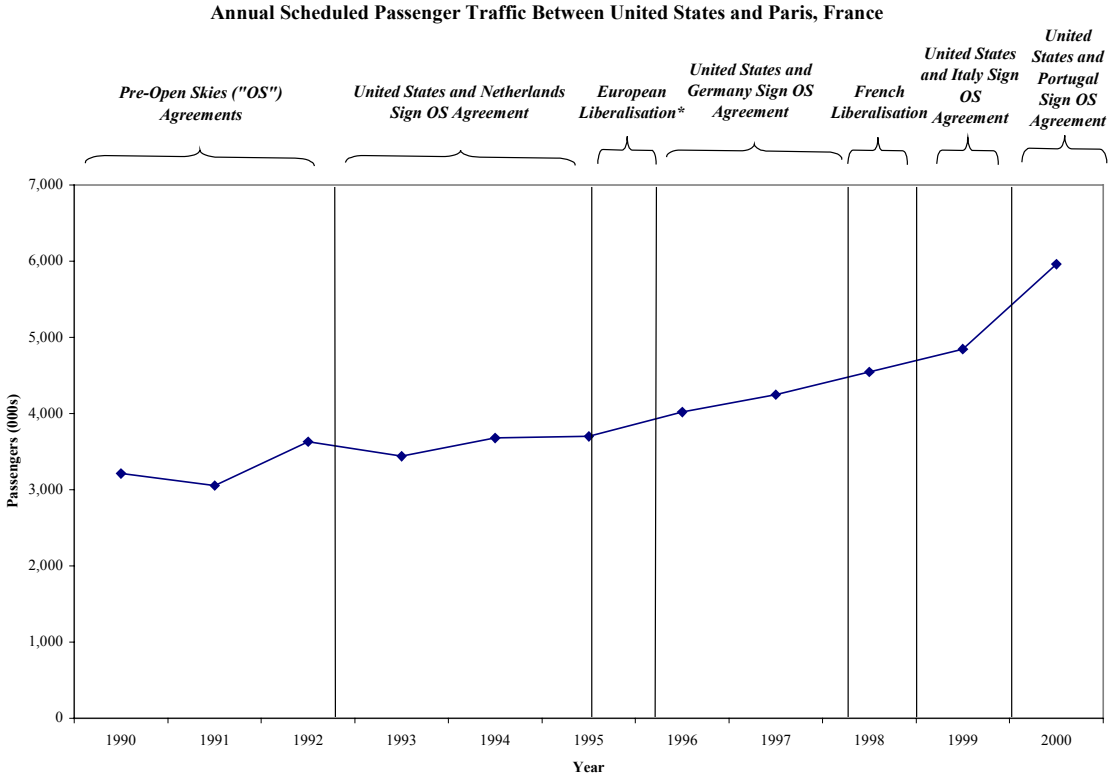
Figure 35



Source: US DOT T-100 International Databank.

** Open Skies Agreements signed between the United States and Austria, Belgium, Denmark, Finland, Iceland, Luxembourg, Norway, Sweden, and Switzerland.*

Figure 36



Source: US DOT T-100 International Databank.
** Open Skies Agreements signed between the United States and Austria, Belgium, Denmark, Finland, Iceland, Luxembourg, Norway, Sweden, and Switzerland.*

6.B COMPARING THE NETHER LANDS, BELGIUM, AND GERMANY DURING THE OPEN SKIES PERIOD

Based on our prior regression results from Section 4.D, we augmented and refined our predictions to further assess whether the Netherlands had experienced a first-mover advantage in aviation liberalisation. We assessed the percentage difference in actual and predicted passenger volumes over three specific periods of interest:

- the period between the Netherlands-US Open Skies agreement and the Belgium-US Open Skies agreement
- the period between the Belgium-US Open Skies agreement and the Germany-US Open Skies agreement
- the period after the Germany-US Open Skies agreement through 2000

For reference purposes, the percentage difference between actual and predicted passenger volumes was also calculated over the period prior to Dutch liberalisation and for the year 2000 (which represents the final year of our data).

The sample data used in estimating our regression coefficients contained observations for the period prior to each country's Open Skies agreement with the United States.[29] Thus, for Belgium-US flight segments, our data sample included all observations of city-pair passenger volumes (and relevant economic variables) for the period prior to Belgium's 1995 Open Skies agreement with the United States. Some observations were taken therefore from the period after the Netherlands completed its Open Skies agreement with the United States. Similarly, for Germany, the data sample included passenger volumes and other economic variables for German routes prior to the 1996 Germany-US Open Skies agreement. Our augmented analysis consequently includes predictions of passenger volumes over periods contained in our regression data sample, as well as predictions of passenger volumes for periods that were outside of our sample data. This approach therefore combines the use of "in-sample" and "out-of-sample" prediction methods. In both cases, the predicted volumes represent the passenger volumes that would have arisen in the absence of liberalisation.

Table 12 presents the refined prediction results. It is notable that the difference between actual and predicted passenger volumes for the Netherlands averaged about 63 percent for the period subsequent to the Germany-US Open Skies agreement. In fact, the difference between actual and predicted passenger volumes for the Netherlands increased over the three periods of interest. Belgium's actual passenger volumes were substantially below its predicted volumes in the period after the Netherlands-US Open Skies agreement became effective. In the period after Belgium and Germany had both entered into their Open Skies agreements, Belgium's actual passenger volumes improved relative to their predicted levels (although they remained well below the predicted levels). The percentage difference between Germany's actual passenger volumes and the predicted volumes were not substantially affected by the Germany-US Open Skies agreement.

Table 12

In-Sample and Out-of-Sample Predictions vs. Actual Scheduled Passenger Traffic

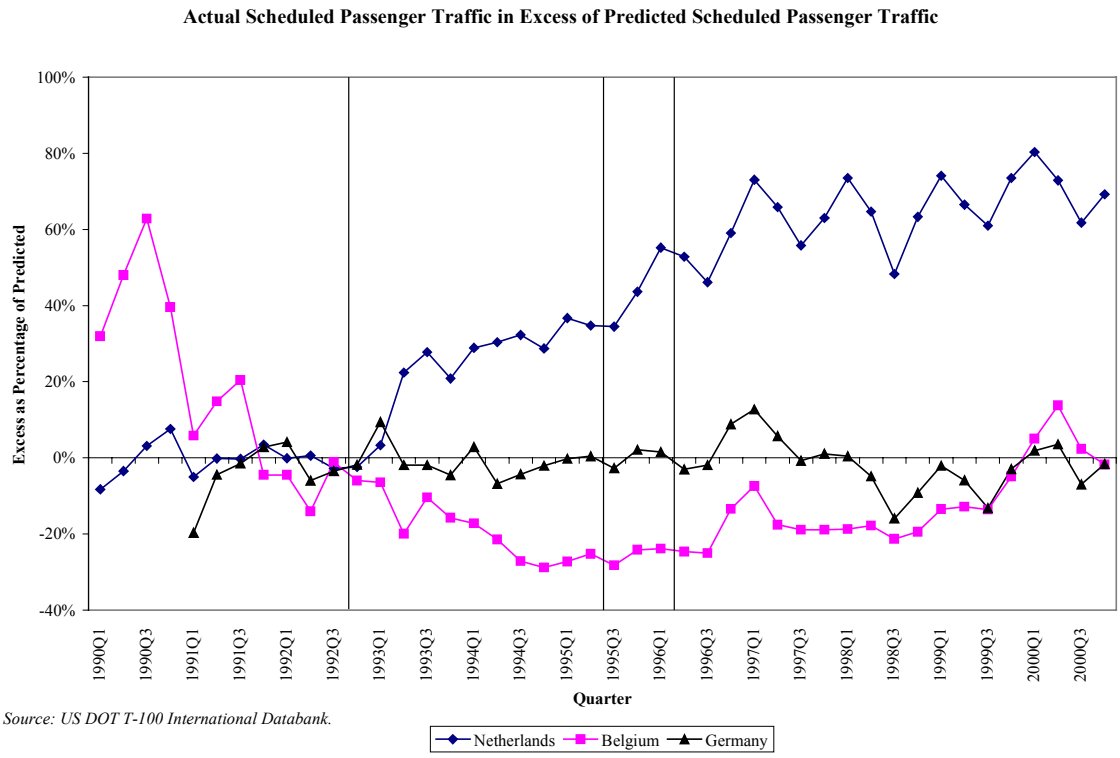
Country	*Actual Total Traffic - Predicted Traffic as Percentage of Predicted Traffic:*				
	Before Netherlands-US Open Skies Agreement	*Between Netherlands-US Open Skies Agreement and Belgium-US Open Skies Agreement*	*Between Belgium-US Open Skies Agreement and Germany-US Open Skies Agreement*	*After Germany-US Open Skies Agreement*	*Year 2000*
Netherlands	-0.4%	23.8%	37.2%	63.5%	70.1%
Belgium	17.6%	-18.9%	-26.1%	-12.2%	5.0%
Germany	-3.7%	-1.7%	-0.3%	-2.6%	-1.2%

Source:
US DOT T-100 International Databank.

[29] We used data for traffic between the United States and the same seven countries used in Section 4.D: Austria, Belgium, France, Germany, Italy, the Netherlands, and Portugal.

Figure 37 offers a graphical depiction of the above results. In every period after the Netherlands-US Open Skies agreement was completed, the percentage difference between actual and predicted transatlantic passenger volumes is greater for the Netherlands than for Belgium and Germany.[30] Most strikingly, the percentage difference between actual and predicted passenger volumes for the Netherlands continued to grow even after Belgium and Germany completed their Open Skies agreements with the United States. Moreover, it does not appear that the other two countries are significantly closing their gaps with the Netherlands.

Figure 37



Source: US DOT T-100 International Databank.

One might expect that the benefits to the Netherlands from liberalisation with the United States would be somewhat reduced after Belgium (and six other European countries) completed an Open Skies agreement in 1995 and Germany completed an Open Skies agreement in 1996. On the contrary, Figure 37 shows that the Netherlands has derived increasing benefits from its liberalisation. This is consistent with a "first-mover" advantage that might be expected in an aviation industry characterised by network economies.

The Netherlands-US Open Skies agreement facilitated Schiphol's early development as a hub airport for transatlantic traffic, with an increased number of transatlantic flights and an expanded transatlantic route network. With frequent transatlantic flights and links

[30] Since we are using "in-sample" predictions of transatlantic passenger volumes for Belgium and Germany during the period between the Netherlands-US Open Skies agreement and these countries' own Open Skies agreements, we typically would expect that our predicted passenger volumes should be relatively close to actual volumes.

to many different locations in the United States, Schiphol became increasingly attractive as a transfer point for passengers within Europe. As such, Schiphol was able to maintain and expand its role as a transatlantic hub even as other European countries entered into their own Open Skies agreements.

6.C CONCLUSIONS

This analysis confirms what our simple comparisons indicate: the Netherlands experienced a first-mover advantage by liberalising its aviation policy with the United States before other countries in Europe. As predicted by economic theory, the Netherlands benefited soon after it entered into the Open Skies agreement, and the effect has persisted in the face of increased competition by carriers from the other liberalising countries.

7. Economic Impacts

Previous sections have analysed the impact of the Netherlands-US Open Skies agreement (and liberalising agreements between the Netherlands and other countries), focusing largely on the effect of liberalisation in terms of increased passenger volumes and routes offered. However, if international aviation liberalisation brings about increased passenger volumes as a result of lower fares and enhanced service offerings, employment in the aviation sector should increase and consumers of air transportation should be better off. This section therefore estimates the impact of the Netherlands-US Open Skies agreement on employment in the Netherlands aviation sector, consumers travelling between the Netherlands and the United States, and output in the airline industry and related upstream industries.

7.A EMPLOYMENT EFFECTS

To estimate the increase in employment associated with the Netherlands-US Open Skies agreement, we first rely on our estimate of the increased passenger volumes attributable to Open Skies, as previously described in Section 4.[31] This increase in passenger traffic should affect employment at Schiphol itself. The employment increase would include KLM and Martinair personnel (and personnel of US transatlantic carriers) needed to support the larger traffic volume on their airlines, as well as non-airline personnel working at Schiphol.

To estimate the employment effect, we relied on a study of Schiphol airport that included employment data.[32] Using the airport employment estimates along with counts of the total number of scheduled and chartered passengers (from the Schiphol Counts data), we calculated a passengers-per-employee ratio for Schiphol airport, which equalled 720 in the year 2000.

Dividing the estimated increase in passenger volumes attributable to Open Skies by the passengers-per-employee ratio for Schiphol, we obtain an estimate of the increased employment associated with Open Skies. Our estimate of the increased employment at Schiphol was approximately 2,500 employees in the year 2000. Note that this result suggests that the Open Skies agreement produced only modest employment increases in the Netherlands.

A few caveats about this result are worth noting. First, if KLM expanded employment at its headquarters in Amstelveen due to the increased passenger traffic, then we have underestimated the impact of Open Skies on Dutch employment. It has been estimated

[31] By comparing the actual Netherlands-US passenger volume with the volume predicted in the absence of Open Skies, our results suggest that passenger traffic between the two countries was 70 percent higher under Open Skies in 2000.

[32] K.J.C. Senden, "Overzicht Van De Werkgelegenheid Op De Luchthaven Schiphol," Regioplan Onderzoek Advies en Informatie, Amsterdam, October 31, 2001: 20.

elsewhere that KLM's employees at Amstelveen account for approximately five percent of total employment at Schiphol.[33]

Second, it is possible that some additional KLM and Martinair employees would be needed in the United States to handle the added transatlantic volume. Alternatively, some KLM and Martinair employees might be required in other European countries that feed passengers into Schiphol. If these employees are of Dutch nationality, then we will have underestimated the impact of Open Skies on Dutch employment. By contrast, if any of the US carriers' employees at Schiphol are US citizens, then we have overestimated the impact on Dutch employment.

Our analysis also assumes that airport employment rises proportionately with passenger volumes. While flight crew and ground-support staff employment may rise substantially as passenger volumes increase, the same may not occur for other airport occupations (*e.g.*, administrative staff). If this is the case, we have likely overestimated the Open Skies employment impact.

On balance, however, we expect that the above sources of under- and over-estimation are probably small in magnitude relative to our overall employment estimate.

7.B CONSUMER SURPLUS EFFECTS

Methodology

Consumer surplus is a common measure of the economic benefits received by consumers that purchase and use a particular product. In this section, we provide a brief overview of our methodology and offer estimates of the gains in consumer surplus attributable to the Netherlands-US Open Skies agreement. A more detailed description of the concept of consumer surplus and our measurement methodology are contained in Appendix II.

The additional consumer surplus arising from Open Skies liberalisation has two components. First, existing passengers enjoy increased surplus if the price they pay for air travel is reduced (or if the quality of air travel is improved). Second, price reductions (or service improvements) stimulate additional air travel, and each new passenger may derive value from air travel that exceeds the price of the travel.[34]

[33] However, it is not certain that administrative employment at KLM headquarters would expand to the same extent as employment in other airline occupations, such as flight crew and ground support.

[34] We recognise that, as a result of aviation liberalisation, consumers may benefit not only from lower fares, but also from improved service in the form of more frequent flights or flights between additional city pairs. Our consumer surplus analysis considers the value of improved service as equivalent to a price reduction that is the same for all consumers. This is an admittedly ambitious assumption, given that different consumers may attach different values to an improvement in service quality. However, to more reliably estimate gains in consumer surplus, one must perform an analysis that lies well beyond the scope of this study and depends on detailed information on the purchasing behaviour and personal attributes of individual consumers of transatlantic air transportation services.

To quantify these two types of benefits, one must estimate both the change in passenger volumes and the change in airfares associated with Open Skies. One also requires information on actual passenger volumes and airfares.

To obtain an estimate of actual fare levels, we relied on various industry sources. For actual passenger volumes, we again referred to the US Department of Transportation's T-100 databank. Regarding the increase in passenger volumes associated with Open Skies, we used the 51 percent figure that represented the difference between actual and predicted passenger volumes for the Open Skies period, as described previously in Section 4.D.

In deriving an estimated change in airfares associated with this change in passenger volumes, we relied on existing academic studies that analysed the price-responsiveness of demand in air transportation. These studies produced a range of estimates for the "price elasticity of demand" for air transportation,[35] generally between 1.0 and 2.5.[36] Using these two figures as our "low" and "high" elasticity estimates, we could impute a given percentage price change that is associated with a specified percentage change in passenger volumes.

Starting with actual passenger volumes for 2000 and airfares in January 2001, we estimated the passenger volume level that would have arisen in the absence of Open Skies.[37] Since Open Skies was assumed to increase the passenger volume level by 51 percent, we divided the actual volume by 1.51 to obtain an estimated passenger volume in the absence of an Open Skies agreement. Based on our assumed price elasticity of demand (either 1.0 or 2.5), we then calculated the fare increase that would have resulted in this lower passenger volume level.[38] This provided an estimate of the airfare

[35] The "price elasticity of demand" measures the percentage change in the quantity demanded that results from a 1-percent change in the price of the product. For example, a demand elasticity of 1.0 implies that sales increase by 1 percent when price falls by 1 percent, while a demand elasticity of 2.5 implies that sales increase by 2.5 percent when price falls by 1 percent. Conversely, a 1-percent increase in sales would arise through a 1-percent drop in price when the demand elasticity equals 1.0, while the same sales increase would arise through a mere 0.4 percent drop in price when the demand elasticity equals 2.5. Thus, as the elasticity of demand increases, a smaller drop in price is needed to induce a specified increase in passenger volumes. This implies that our calculated consumer benefits become smaller as the assumed elasticity of demand increases in magnitude.

[36] "Under all specifications, the price elasticity of demand …lies between [2.50] and [2.25]" (Brueckner and Spiller, "Economies of Traffic Density," 405). See also James A. Brander and Anming Zhang, "Market Conduct in the Airline Industry: An Empirical Investigation," *RAND Journal of Economics* 21, no. 4 (Winter 1990): 567-583. Based on prior literature, Brander and Zhang estimate the price elasticity of demand for airline services to be 1.6.

[37] As described in Appendix II, we estimate the consumer surplus increase for each route and then combined the estimates to obtain a total increase in consumer surplus. Our analysis included twelve routes between Schiphol and the United States. The US gateway cities were Atlanta, Boston, Chicago, Detroit, Houston, Los Angeles, Memphis, Minneapolis-St. Paul, New York, Seattle, San Francisco, and Washington, DC.

[38] As mentioned previously, our analysis assumes that all consumer benefits from Open Skies liberalisation are realised through fare decreases. These fare changes represent the reductions needed to stimulate a 51 percent increase in passenger volume on each route, based on the assumed price elasticity of demand. An elasticity of 2.5 implies that a 20 percent fare reduction is required (representing an average fare decrease of €142 in our data), while an elasticity of 1.0 implies a 51 percent fare reduction is required (representing an average fare decrease of €405). Therefore, in the

that would have arisen in the absence of Open Skies. The estimates of airfares and passenger volumes with and without Open Skies, along with our assumed demand elasticity, were then used to calculate the change in consumer surplus.

Results

The results of our consumer surplus analysis are presented in Table 13 below. We estimate that the consumer surplus gain associated with the Netherlands-US Open Skies agreement ranged from €0.5 billion to €1.4 billion per year. These total benefits accrued to passengers in the Netherlands and the United States (and those from elsewhere who flew through Schiphol). From the Schiphol Survey data, we estimate that approximately 17 percent of the passengers travelling from Schiphol to the United States in 2000 were of Dutch nationality. This implies that approximately €85 million to €245 million per year of the increase in consumer surplus is realised by Dutch nationals.[39]

Table 13

Predicted Increase in Consumer Surplus Due to Netherlands Open Skies Agreement (€mn in 2000)

Elasticity = 1.0			*Elasticity = 2.5*		
Gains Due to Price Decreases for Existing Customers	*Gains Due to Increased Traffic*	*Total Gains*	*Gains Due to Price Decreases for Existing Customers*	*Gains Due to Increased Traffic*	*Total Gains*
1,149	255	1,404	403	94	497

Source:
DOT T-100 International Databank and BAe Database.
Notes:
Utilizes January 2001 fares derived from the BAe Database.

7.C OUTPUT EFFECTS IN AVIATION-RELATED INDUSTRIES

Another measure of the economic impact of Open Skies is the effect that increased demand for air transportation has on other industries in the Netherlands. An increase in

consumer surplus calculations, we assume that liberalisation through Open Skies agreements is associated with a fare decrease ranging from 20 to 51 percent on each transatlantic route between Schiphol and the United States. However, in reality, the increased consumer benefits under Open Skies have arisen as a combination of fare reductions and service improvements. Another way of viewing our analysis is that we estimate the combined value of fare reductions and service improvements as equal to 20 to 51 percent of prevailing airfares.

[39] Not all of the consumer gains represent true improvement in social welfare. In particular, the gains attributable to price decreases for existing passengers represent a transfer of welfare from producers to consumers. From the perspective of the Dutch economy, the price reductions may reduce overall social welfare if Dutch producers account for a larger share of the Netherlands-US air transportation market than Dutch consumers. However, increased passenger traffic under Open Skies represents a likely source of gains to both consumers and producers. The consumer value of transatlantic travel for some passengers exceeds the price of the travel, while producers (i.e., airlines) may receive a price for the travel that exceeds the incremental cost of the additional passenger traffic. Finally, note that the estimates in Table 13 apply to all consumers of Netherlands-US transportation services, not merely Dutch citizens.

air traffic volumes would result in increased demand for such inputs as aircraft, fuel, replacement parts, maintenance services, advertising, and computer and office equipment. The extent of these increases can be estimated using a measure of how much of various inputs are required to produce one unit (*e.g.*, one euro or one dollar) of air transportation output.

The 1996 Annual Input-Output Accounts for the United States provide a detailed description of the various inputs needed to produce output in various industries.[40] We use this source as a means of estimating how increased demand for air transportation leads to increased spending in upstream sectors that supply the airline industry.

Based on the US input-output accounts, Appendix III displays the "direct" and the "direct and indirect" shares for select inputs, as well as all inputs combined. The direct shares represent the cost of inputs into air transportation, expressed as a percentage of air transportation revenue. They also include the "value added" within the airline industry, which represents payments to labour and capital in the industry. In total, the direct input shares necessarily sum to one.

By contrast, the "direct and indirect" input shares represent the total impact that increased demand for air transportation has on all industries, considering that increased demand for inputs into air transportation (*e.g.*, aircraft and parts) creates increased demand in other industries (and so on). As a result of these direct and indirect effects, a €1 increase in air transportation demand creates more than €1 of additional output.

The combined "direct and indirect" shares represent the increase in output in each industry that arises from increased demand for air transportation after all economic interactions are considered. Each industry's "share" represents the increase in that industry's output, expressed as a percentage of the initial increase in air transportation revenue. Since a €1 increase in air transportation demand creates more than €1 of overall economic output, the shares add up to a number in excess of one. In fact, based on the input-output accounts for the United States, a €1 increase in air transportation demand generates an additional €1.84 in output across all industries.

We apply these input share estimates to the increase in "passenger demand" associated with Open Skies. This increase in demand is based on the predicted increase in passenger volumes from Open Skies, multiplied by the fare levels observed under Open Skies.[41] By taking the predicted demand change and multiplying by the input shares described in Appendix III, we obtain estimates of the increased spending in specific sectors that arises from aviation liberalisation (as well as an estimate of the overall

[40] Sumiye O. Okubo, Ann M. Lawson, and Mark A. Planting, "Annual Input-Output Accounts of the U.S. Economy, 1996," *Survey of Current Business* (January 2000): 37-86. We did not have commensurate data for the Netherlands. However, a recent study estimated the "input-output" multiplier for air transportation for the Netherlands to be 1.7. The *Survey of Current Business* estimates that the "input-output" multiplier for US air transportation is 1.84. Thus, the US and Dutch multiplier estimates for air transportation are quite close to one another.

[41] The predicted increase in passenger demand is the difference between the Open Skies volume and the volume that would have been realised without Open Skies (*i.e.*, the Open Skies volume divided by 1.51, based on the 51 percent increase in volume attributable to Open Skies).

spending increase). These results for the overall economic impact are presented in Table 14.

Table 14

Total Estimated Increase in Direct and Indirect Economic Activity (€mn per year)

	Revenue	*Economic Impacts*
Direct Effects Only	1,149	1,149
Direct and Indirect Effects	1,149	2,120

Table 14 indicates there would be approximately a €1.15 billion per year increase in passenger demand from Open Skies. This would translate into a €1.15 billion per year increase in direct spending in the industries that supply the air transportation industry (including the "value added" within the airline industry). Once we take into account all direct and indirect economic interactions arising from the increased demand for air transportation, the increase in output equals approximately €2.12 billion per year.

We also show how the output increases are distributed across the various industrial sectors. Table 15 shows how direct and indirect spending affects six of the industrial sectors analysed. The largest effects are in the air transportation and petroleum industries.[42]

Table 15

Total Estimated Increase in Direct and Indirect Economic Activity (€mn per year)

Sector	*Direct Effects*	*Direct and Indirect Effects*
Petroleum refining and related products	100	110
Aircraft and parts	33	39
Air transportation	646	1,164
Pipelines, freight forwarders, and related services	98	139
Computer and data processing services, including own-account software	24	44
Other business and professional services, except medical	19	48

Note: The Air Transportation direct effects include the value added in the industry. This amount reflects payments to capital and labour.

The above estimates of increased output pertain to all firms that supply the providers of air transportation between the Netherlands and the United States, wherever they are located. It is, however, unlikely that all upstream firms supplying the providers of air

[42] It takes air transportation to produce goods that are inputs into the production of air transportation, and the indirect effects capture these impacts.

transportation between the Netherlands and the United States are located within the Netherlands. Moreover, the providers of air transportation include both Dutch and US airlines. Lacking data that describes the proportion of each input acquired from Netherlands' sources, the above estimates necessarily exceed the output effects realised in the Netherlands (as a result of Open Skies).[43]

In addition, we have not estimated any change in spending in "related" industries, such as lodging or food service, that are stimulated as a result of increased demand for air transportation. Some argue that increases in passenger traffic would result in greater spending on hotels and restaurants. However, to consider these effects properly, one would need to account explicitly for how lower fares for air transportation affect consumers' entire budget allocation. One possibility is that relatively more money is spent on vacation and business travel, but less money is spent elsewhere. To avoid overstating the possible gains from Open Skies, we have refrained from estimating any "macro"-economic benefits other than those described above.

Finally, these numbers represent merely industry output increases associated with increased passenger volumes under Open Skies. Given that resources are likely taken from other industries in order to produce increased output of air transportation and its associated inputs, these estimates do not necessarily constitute an additional source of overall economic benefit. Instead, they represent a means of identifying specific industries that may have benefited from Open Skies, although those benefits may have come at the expense of output in other industries.

[43] Also, Table 15 might not represent the distribution of effects in the Netherlands if the Dutch industries supplying the air transportation industry are not distributed in the same manner as in the US Input-Output Accounts.

8. Conclusions

In this study, we assessed the economic effects of Dutch aviation liberalisation. Particular emphasis has been placed on liberalisation with the United States, Kenya, Malaysia, and Brazil.

Our analysis has included simple comparisons of the growth in passenger and freight traffic between the Netherlands and these four countries before and after liberalisation. In addition, we have contrasted the behaviour of passenger and freight volumes between the Netherlands and these countries, as opposed to countries with more restrictive bilateral aviation agreements with the Netherlands. We also have used regression techniques to isolate changes in passenger volumes attributable to aviation liberalisation from volume changes associated with changing cost and demand conditions.

The Netherlands in general, and Schiphol in particular, has enjoyed substantial increases in passenger and cargo volumes that are associated with aviation liberalisation involving the United States, Kenya, and Malaysia. We found inconclusive evidence regarding the impact on passenger and freight volumes of Dutch liberalisation with Brazil. This inconclusive outcome perhaps may be attributable to the difficulties in fully accounting for the impact of Brazil's recent economic problems on air travel demand.

Our regression analysis suggests that the Open Skies agreement between the Netherlands and the United States (signed in September 1992) was associated with a 51 percent increase in transatlantic passenger traffic involving the two countries. We find that Dutch aviation liberalisation with Kenya in 1993 and 1997 was associated with a combined 96 percent increase in passenger volumes between the two countries. Our results further suggest that the 1991 aviation liberalisation between the Netherlands and Malaysia was associated with a 20 percent increase in passenger traffic. A 36 percent increase in passenger traffic was associated with the 1995 aviation liberalisation between the two countries, resulting in a combined 63 percent volume increase from both liberalisation agreements. On balance, the impact of Dutch aviation liberalisation with the United States, Kenya, and Malaysia has been quite sizeable.

In addition, the evidence suggests that the Netherlands has benefited greatly from its lead position in being the first European country to sign an Open Skies agreement with the United States. As one example, Schiphol experienced a larger percentage growth rate in annual passenger traffic over the 1992-2000 period than other major European transatlantic hubs (Brussels, Frankfurt, London, and Paris). For another example, our regression analysis indicates that, after controlling for changes in cost and demand conditions affecting air travel, the Netherlands showed larger percentage increases in passenger volumes than Belgium and Germany over the period subsequent to its Open Skies agreement. Moreover, the increase in passenger volumes attributable to Open Skies liberalisation with the United States remained substantially higher for the Netherlands even after Belgium and Germany entered into their Open Skies agreements.

Based on the above evidence, the Netherlands appears to have gained a considerable "first-mover" advantage by entering into the first Open Skies agreement with the United States. Apparently, this agreement stimulated Schiphol's early development as an

attractive hub airport. Due to network and density economies arising from connecting with a high-volume airport, Schiphol remained an attractive hub even after Belgium and Germany liberalised their aviation agreements with the United States.[44]

The main focus of this report has been to determine the impact of Dutch air transport liberalisation on passenger and freight volumes between the Netherlands and the United States, Kenya, Malaysia, and Brazil. However, we also examined more general economic impacts arising from the Netherlands-US Open Skies agreement.

Our analysis estimated the employment impacts arising from the Open Skies agreement, as well as impacts on consumer welfare and spending on upstream industries that serve the air transportation sector. We estimate that the Open Skies agreement has led to approximately 2,500 additional employees in the Netherlands as of 2000. Again, this estimate is an approximation that does not consider certain factors that may boost or diminish the employment impact.

We estimated that consumers have gained approximately €500 million to €1.4 billion annually due to the Open Skies agreement with the United States. All passengers who travel through Schiphol—Dutch, American, European, and other nationalities—share these gains. We estimate that approximately 17 percent of the passengers travelling from Schiphol to the United States in 2000 were of Dutch nationality. This implies that approximately €85 million to €245 million per year of the increase in consumer surplus was realised by Dutch nationals. Again, it must be noted that the gain in consumer welfare does not represent an overall social welfare gain to the Dutch economy. A large part of these gains result from fare reductions (or service improvements) for existing passengers, which are a source of lost revenues to the Dutch airlines that experience the lower fares.

Finally, we have estimated that, by the year 2000, the airline industry and associated suppliers have experienced increased output ranging between €1.15 billion (in direct effects only) and €2.12 billion (in direct and indirect effects) due to the Open Skies agreement.[45] These industries have increased their output because the Open Skies agreement has led to an estimated 51 percent increase in passenger traffic. This extra traffic requires more aircraft, parts, fuel, and other inputs. Lacking more refined data on the location of suppliers serving Netherlands and US transatlantic carriers, we were unable to allocate the increased output to industries located within the Netherlands.

We have calculated each of these economic impacts in isolation without considering how these changes would affect, or be affected by, the rest of the Dutch economy. Therefore, it is not appropriate to combine our estimates of employment benefits, consumer benefits, and increased output to obtain an overall estimate of the economic impact of Open Skies. The employment and output estimates do not account for the opportunity cost of the resources involved, and therefore do not represent "true"

[44] *Economies of density* arise in aviation (and other network industries) when a firm's average cost decreases as more customers use its network.

[45] As stated above, we have not estimated any change in spending in "related" industries, such as lodging or food service, that are stimulated as a result of increased demand for air transportation.

improvements in social welfare. Moreover, as mentioned previously, the consumer gains include transfers from producers to consumers. Without additional data, we cannot calculate the true social benefits to the Dutch economy from aviation liberalisation.

Despite the above data limitations, the evidence still suggests that Schiphol and the Netherlands have benefited significantly from aviation liberalisation. In addition, it appears that the timing of liberalisation has influenced the related benefits. In particular, the Netherlands' lead role in signing an Open Skies agreement with the United States has provided "competitive" advantages that have fostered Schiphol's development as a major aviation hub. The benefits of liberalisation likely would have been substantially smaller if the Netherlands had concluded its Open Skies agreement subsequent to other European countries.

Appendix I: Open Skies Impact Evaluation Methodology

Our Methodology and Data

To reasonably assess the impact of the Netherlands-US Open Skies agreement, we performed a regression analysis to estimate the impact on passenger volumes that arose on transatlantic routes subsequent to the completion of Open Skies agreements between the United States and the Netherlands, Belgium, and Germany. To improve the reliability of our analysis, we refined our coefficient estimates by including data from Austria, France, Italy, and Portugal, which represent four other countries that liberalised their aviation agreements with the United States.

Regression techniques also were used to identify the impact of aviation liberalisation between the Netherlands and Kenya, Malaysia, and Brazil. This appendix describes our data, explains the methodology underlying our analysis, presents our actual statistical specifications, and reports the coefficient estimates from our regression analysis.

Data

The analysis of traffic volume for the Open Skies effects relied primarily on T-100 international segment data from the US Department of Transportation, which provides monthly traffic on transatlantic city-pair routes. We aggregated the T-100 volumes up to the quarterly level, since the other variables described below were only available at the quarterly level. The analysis of traffic for Kenya, Malaysia, and Brazil relied on the Schiphol Counts data, which were available at the monthly level. Again, we aggregated the volumes to the quarterly level to match the frequency of the other independent variables.

We estimated the relationship between volume and cost and demand factors. The cost factor was a constructed cost index for airlines, based on the one used by the US Department of Transportation, which includes fuel, labour, fleet, fees, and other costs associated with producing airline transportation. We used either the fuel and labour portion or just the fuel portion in the regressions below. We controlled for demand by using the quarterly real US disposable income or the Dutch GDP, as well as the foreign country's GDP. We also added a variable to control for the real exchange rate between the United States and the seven European countries in the out-of-sample regression, or the Netherlands and the six countries in the in-sample regressions. Table 16 includes the independent variables we used in the estimation, their source, as well as the mean and standard deviation for each.

Table 16

Summary Statistics for Independent Variables

	Variable	Statistic	Panel A: T-100 Out-of-Sample Model						
			Austria	*Belgium*	*France*	*Germany*	*Italy*	*Netherlands*	*Portugal*
[1]	Real GDP of Country	Mean	8.55	2.95	17.95	60.11	0.07	54.47	0.01
		Std. Dev.	0.91	0.30	1.76	6.95	0.01	5.19	0.00
[2]	Real Exchange Rate	Mean	8.57	2.99	18.04	60.44	0.06	55.34	0.62
		Std. Dev.	0.88	0.33	2.05	7.51	0.01	5.42	0.06
[3]	Real ATA Cost Index	Mean	123.32	123.32	123.32	123.59	123.32	123.32	123.32
		Std. Dev.	4.35	4.35	4.35	4.44	4.35	4.35	4.35
[4]	Real US Disposable Income	Mean	5631.85	5631.85	5631.85	5721.33	5631.85	5631.85	5631.85
		Std. Dev.	635.28	635.28	635.28	595.37	635.28	635.28	635.28

		Statistic	Panel B: Schiphol Counts Data Set In-Sample Model					
			Argentina	*Brazil*	*India*	*Malaysia*	*Kenya*	*Nigeria*
[5]	Real GDP of Country	Mean	448.09	1,114.87	754.39	136.53	19.72	140.60
		Std. Dev.	146.51	330.80	160.03	45.98	3.98	88.47
[6]	Real Exchange Rate	Mean	157.24	214.51	7.63	76.03	3.76	7.51
		Std. Dev.	60.02	102.13	2.05	13.70	0.62	5.45
[7]	Fuel Index	Mean	74.47	74.47	74.47	74.47	74.47	74.47
		Std. Dev.	11.43	11.43	11.43	11.43	11.43	11.43
[8]	Real Dutch GDP	Mean	173.17	173.17	173.17	173.17	173.17	173.17
		Std. Dev.	28.70	28.70	28.70	28.70	28.70	28.70

Notes:
T-100 variables are expressed in 1998 Q2 US Dollars, and Schiphol Counts variables are expressed in 2000 Q4 Dutch Guilders.
In Panel A, data reflect quarterly observations from 1990:1 - 2000:4, except for Germany's statistics, which reflect observations from 1991:1 - 2000:4.
In Panel B, data reflect quarterly observations from 1985:1 - 2000:4, except for Brazil's GDP and CPI statistics, which reflect observations from 1986:1 - 2000:4.
Sources:
[1]: Eurostat. For Portugal, Portuguese Central Bank and the OECD.
[2]: Eurostat. For Austria, Consumer Price Index from IMF's International Financial Statistics database is used.
[3]: Derived from the labour and fuel components of the Air Transport Association's Airline Cost Index, Fourth Quarter 2001.
[4]: US Department of Commerce, Bureau of Economic Analysis.
[5]: IMF International Financial Statistics Database.
Data expressed in billions 2000Q4 Dutch guilders.
[6]: IMF International Financial Statistics Database.
Brazil CPI is missing prior to 1990. Data from Dr. Marc-Andreas Muendler's website is used to continue IMF series to 1986.
http://econ.ucsd.edu/~muendler/html/brazil.html
[7]: Derived from the fuel component of the Air Transport Association's Airline Cost Index, Fourth Quarter 2001.
Data expressed in nominal US$.
[8]: Non-seasonally adjusted GDP, as reported by Statistics Netherlands (CBS)

Methodology

Using regression techniques, we implemented two different types of tests to assess the impact of aviation liberalisation. One test was used in analysing the effects of the Netherlands-US Open Skies agreement. Since we had a sufficient number of data points, our regression specification was estimated using data only from time periods where no liberalisation agreement was in effect between the United States and the relevant European country (*i.e.*, Austria, Belgium, France, Germany, Italy, the Netherlands, and Portugal). We then predicted passenger volumes over the period after that country entered

into an Open Skies agreement with the United States, and compared those estimates with the actual levels observed in the market. These are known as "out-of-sample" predictions.

Our second test was used in identifying the impact of aviation liberalisation with Kenya, Malaysia, and Brazil. In this case, our regression specification was estimated using data for the entire 1985-2000 time period (except for the Brazil regression, where the available macroeconomic data began in 1986). We included "indicator" (*i.e.*, "dummy") variables in our regression analysis, which were intended to isolate any impacts on passenger volumes that arose subsequent to aviation liberalisation agreements between the Netherlands and Kenya, Malaysia, or Brazil. The indicator variables identified changes in passenger volumes during the liberalisation period that were not explained by the cost and demand factors included in our regression specifications. This approach involved identifying the impact of liberalisation through an "in-sample" test.

The indicator variable for a specific country was set equal to one for each quarterly observation where that country's liberalised agreement with the Netherlands was in effect during the entire quarter, and zero for all other quarters before the agreement.[46] (For example, given that the Netherlands signed an aviation liberalisation agreement with Kenya in August 1993, the associated indicator variable equalled zero during each quarter from 1985:1 to 1993:3, and it equalled one from 1993:4 to 2000:4.) Using this approach, the combined impact of two or more liberalising agreements is necessarily "cumulative", depending on the total value of the coefficients for the relevant indicator variables.

We relied, where possible, on the out-of-sample estimates in the text because we believe those estimates are more reliable than the in-sample estimates, since we want to obtain an estimate of what international traffic would have been had there been no liberalisation of air transport policies. The in-sample estimates, as described above, include an indicator variable to estimate the effect of the agreements on the traffic volume. And, as explained above, we also include supply and demand variables to control for their effect on traffic volumes. However, in the in-sample regressions, the relationship between supply and demand and volume is estimated over the values both before and after the liberalisation agreements were consummated. If the relationship between these variables changed once the liberalisation occurred, then the estimates on the supply and demand variables will not be the true effect of supply and demand absent any liberalisation. The estimates will be "tainted" by the impact of the agreements.

In the out-of-sample estimation, we do not encounter this problem, since we are only estimating the coefficients in the model over those quarters where there was no agreement in place. The only caveat to this is that we did include quarters for those countries that had not yet signed an Open Skies agreement, even though another country had. For example, we included data from Belgium before the third quarter of 1995. However, the Netherlands had an Open Skies agreement with the United States in place since September 1992. If the Netherlands Open Skies agreement influenced the Belgian supply and demand factors, then we could be faced with the same problem we identified in the in-sample regressions. However, given the fact our data begin in 1990, and the fact the Netherlands-US agreement was so early in the period, we would have lost many of the

[46] For Nigeria, India, and Argentina, the indicator variables were always equal to zero.

potential observations if we had only estimated over the data before the fourth quarter of 1992. We did not believe the other countries' Open Skies agreements would have the same magnitude effect as the own country's Open Skies agreement in changing the coefficients on the supply and demand variables.

We used the in-sample estimation technique for estimating the effects of Dutch air liberalisation on passenger traffic with Kenya, Malaysia, and Brazil because each of these countries had multiple agreements with the Netherlands. We would not be able to predict after the first agreement the traffic after the second agreement, because we would have to run another regression just on the data between the two agreements. We would be limiting the predictive power of the regression by using so few observations, so we decided to utilise the in-sample estimation technique instead. (This also allows us to estimate the impact of the supply and demand variables with more precision, due to the increased number of observations, which may be more useful with the developing countries.)

Rather than comparing volumes across city-pair routes that are subject to differing cost and demand conditions, our principal methodology instead uses a "fixed-effects" model to examine changes on an individual city-pair route subsequent to the completion of an air liberalisation agreement. This approach avoids the need to explicitly account for the different demand (and supply) factors that explain differences in traffic volumes across city-pairs.

The countries included in our analysis for the United States traffic were Austria, Belgium, France, Germany, Italy, the Netherlands, and Portugal. We included Kenya and Nigeria, Malaysia and India, and Brazil and Argentina, separately, in three different regressions for the three other regions of the world.

The Model

For the out-of-sample regression for the Netherlands-US Open Skies impact, we estimated the following regression model:

$$\log(volume) = \alpha + \beta_1 routeFE + \beta_2 qtrFE + \beta_3 Age(a) * NewRoute + \beta_4 Age(b) * NewRoute + \beta_5 Age(c) * NewRoute + \beta_4 \log(Yd) + \beta_5 \log(cstindex) + \beta_6 \log(GDP_{foreign}) + \beta_7 \log(RXR_{foreign}) + \varepsilon,$$

where

- log(*volume*) is the natural log of the quarterly volume
- *routeFE* are route fixed effects dummies
- *qtrFE* are quarter fixed effect dummies
- *Age(a)* equals the age of the route if the route is less than three quarters old; otherwise, it equals two
- *Age(b)* equals zero if the route is less than three quarters old; the age of the route minus two if the route is less than five quarters old; otherwise, it equals two

- *Age(c)* equals zero if the route is less than five quarters old; otherwise, it equals the age of the route minus four [47]
- *NewRoute* is an indicator variable set equal to one if the route was not in existence during the first quarter of available data
- log(*Yd*) is the natural log of real US disposable income
- log(*cstindex*) is the natural log of the fuel and labour portions of the real constructed cost index in US dollars
- log($GDP_{foreign}$) is the log of real foreign GDP for the country of observation, converted to US dollars using the exchange rate
- log($RXR_{foreign}$) is the "real exchange rate"—the ratio of foreign prices (*i.e.*, foreign PPI) for the country of observation to US prices (*i.e.*, US PPI), where the foreign prices are converted to US dollars using the exchange rate
- ε is a random error term

All of the variables are converted to real dollars by deflating them using the US PPI to bring them to the 2nd quarter of 1998. The data used were route-level observations, as described above.

For the in-sample regressions between the Netherlands and the three regions with liberalisation (Asia, Africa, and Latin America), we used the following regression specification:

$$\log(volume) = \alpha + \beta_1 routeFE + \beta_2 qtrFE + \beta_3 \log(GDP_{Dutch}) + \beta_5 \log(fuelindex) + \beta_6 \log(GDP_{foreign}) + \beta_7 \log(RXR_{foreign}) + \beta_8 Agreement_1 + \beta_9 Agreement_2 + \varepsilon,$$

where

- log(GDP_{Dutch}) is the natural log of the Dutch quarterly GDP in Dutch Guilders
- log(*fuelindex*) is the natural log of the fuel portion of the nominal cost index in US dollars
- log($GDP_{foreign}$) is the log of real foreign GDP for the country of observation, converted to Dutch Guilders using the exchange rate
- log($RXR_{foreign}$) is the real exchange rate between the Netherlands and the country of observation, converted to Dutch Guilders using the foreign CPI
- $Agreement_1$ is an indicator variable that was one starting in the first full quarter the first agreement between the Netherlands and the country was in effect; zero otherwise

[47] Based on this construction, the sum of the age variables (*i.e.*, *Age(a) + Age(b) + Age(c))* equals the age of the route for routes that come into existence during the period covered by our data. For pre-existing routes, the *New Route* dummy variable equals zero, implying that the age variables do not affect the estimation of passenger volumes on these routes.

- *Agreement*$_2$ is an indicator variable that was one starting in the first full quarter the second agreement between the Netherlands and the country was in effect; zero otherwise

and the rest of the variables are defined as above. All of the variables are converted to real Dutch Guilders by deflating them using the Dutch PPI to bring them to the 4th quarter of 2000.

For both the out-of-sample and in-sample specifications, we ran weighted least squares regressions. The weight for each observation was the inverse of the variance of the residuals for that observation's route, as determined from an identical first-stage regression. Each observation was multiplied by that weight before the regression was run again.

Results

The results from these regressions are incorporated in full below. A few points are worth noting for the different estimation techniques.

Out-of-Sample

As explained above, for the out-of-sample predictions, we limited the data used to estimate the model to those quarters for which the Open Skies agreements were not in effect. Then, we predicted log(*volume*) for all of the quarters—those with an Open Skies agreement in effect and those without. We took the inverse log of the predictions and added an adjustment factor.[48]

These regression results for the US coefficients and foreign GDP were of the expected sign. The magnitude of the US disposable income coefficient was greater than one, implying that a one-percent increase in US income increases demand for transatlantic travel by more than one percent.

The age coefficients imply that as a route ages, its volume increases but at a decreasing rate. These coefficients capture the fact that new routes tend to have large increases in volume early, but this growth would not be expected to continue for long.

Finally, the R-squared of the regression is 0.96, which means we are explaining 96 percent of the variation in passenger volume differences between the United States and the seven European countries included in the analysis, including the Netherlands. These regression results are presented in Table 17 below.

[48] The adjustment factor was equal to exponent(standard error of the regression squared/2). This was done because we have log values as the dependent variable.

Table 17

Weighted Least Squares Out-of-Sample Results

Independent Variable	*T-100 Out-of-Sample Model*
Intercept	-3.93 (-1.54)
Q1 Dummy	-0.16* (-11.02)
Q2 Dummy	0.17* (11.83)
Q3 Dummy	0.31* (21.56)
Age(a) * New Route Dummy	0.60* (5.27)
Age(b) * New Route Dummy	0.08 (1.77)
Age(c) * New Route Dummy	0.01 (1.74)
Log(Real US Disposable Income)	1.88* (10.84)
Log(Real ATA Cost Index)	-0.30 (-0.51)
Log(Real Foreign GDP)	0.00 (0.02)
Log(Real Exchange Rate)	0.12 (0.57)
Route Fixed Effects	Yes
Observations	**1371**
R-Squared	**0.96**

Notes:
** denotes statistical significance at the 5% level.*
Values in parentheses indicate t-statistics.
Dependent variable is the log of scheduled passenger volume.

Although the real exchange rate variable and other variables are not statistically significant, removing these variables from our specification raises the issue of omitted-variable bias. If there is a factor affecting traffic volumes, and we do not explicitly control for it in our model specification, the regression will assign some of the effect of the omitted variable to the included variables, based on their correlation with the omitted variable. Since many factors affect transatlantic travel, and we have been unable to control for all of them, our results may be biased due to potential omitted variables. We also assume that supply and demand factors affect each of the routes and each of the countries in the same fashion. To the extent this is not true, we will be potentially biasing

our results by not controlling for the differential effects of supply and/or demand on certain routes or in specific countries.

In-Sample

The results from the three separate in-sample regressions are presented in Table 18 below. First, the coefficients for log(GDP_{Dutch}) and log($GDP_{foreign}$) are always positive in sign, and they generally are statistically significant. The cost coefficients are only slightly less reasonable. They are always negative in sign, although only two of the six coefficient estimates are statistically significant.

Table 18

Weighted Least Squares In-Sample Results

Independent Variable	*Schiphol Counts Data In-Sample Models*		
	Kenya and Nigeria	*Malaysia and India*	*Brazil and Argentina*
Intercept	-3.40	-19.80*	-11.51*
	(-1.23)	(-3.42)	(-3.62)
Q1 Dummy	0.04	0.19*	0.10
	(0.68)	(2.53)	(1.54)
Q2 Dummy	-0.02	-0.02	-0.13*
	(-0.37)	(-0.33)	(-2.09)
Q3 Dummy	0.27*	0.23*	0.23*
	(5.36)	(3.28)	(3.65)
Liberalisation Dummy 1	-0.27*	0.18	-0.21*
	(-3.02)	(1.39)	(-2.14)
Liberalisation Dummy 2	0.94*	0.31*	-0.10
	(10.48)	(3.26)	(-1.14)
Log(Real Dutch GDP)	1.31*	2.23*	2.86*
	(8.04)	(3.50)	(10.61)
Log(ATA Fuel Price)	-0.04	-0.33	-0.37*
	(-0.27)	(-1.76)	(-2.36)
Log(Real Foreign GDP)	0.27	0.85*	0.26
	(1.91)	(2.12)	(1.75)
Log(Real Exchange Rate)	-0.02	-0.73*	-0.02
	(-0.15)	(-1.98)	(-0.44)
Route Fixed Effects	Yes	Yes	Yes
Observations	**191**	**225**	**181**
R-Squared	**0.90**	**0.87**	**0.80**

Notes:
** denotes statistical significance at the 5% level.*
Values in parentheses indicate t-statistics.
Dependent variable is the log of scheduled passenger volume.

While we have the same sources of potential bias in the in-sample regressions that were discussed previously, we believe that the biases are not so great as to significantly

affect the coefficient estimates of the agreement indicator variables, which are the primary coefficients of interest in our in-sample regression models.

Conclusions

We believe these regressions are highly useful for predicting the levels of traffic that would have resulted had the Netherlands not liberalised its air transport policies with the various countries. The clearest indication of this is the R-squared of our out-of-sample regression of 0.96, meaning we are explaining 96 percent of the variation in transatlantic traffic with the variables we have included in the model. The high level of explanation we achieve with the model means that even if some of the coefficients may not have the expected sign, as a whole they are still accurately predicting the traffic volumes between the Netherlands and the United States. Since we use these regression estimates to predict what the international traffic patterns out of Schiphol would have been absent liberalisation, we feel confident we are predicting these "but-for" volumes to a reliable degree of accuracy. The R-squared of the in-sample regressions are between 0.80 and 0.90, again indicating a high level of overall predictive power of our models.

Appendix II: Consumer Surplus Calculation

Concept of Consumer Surplus

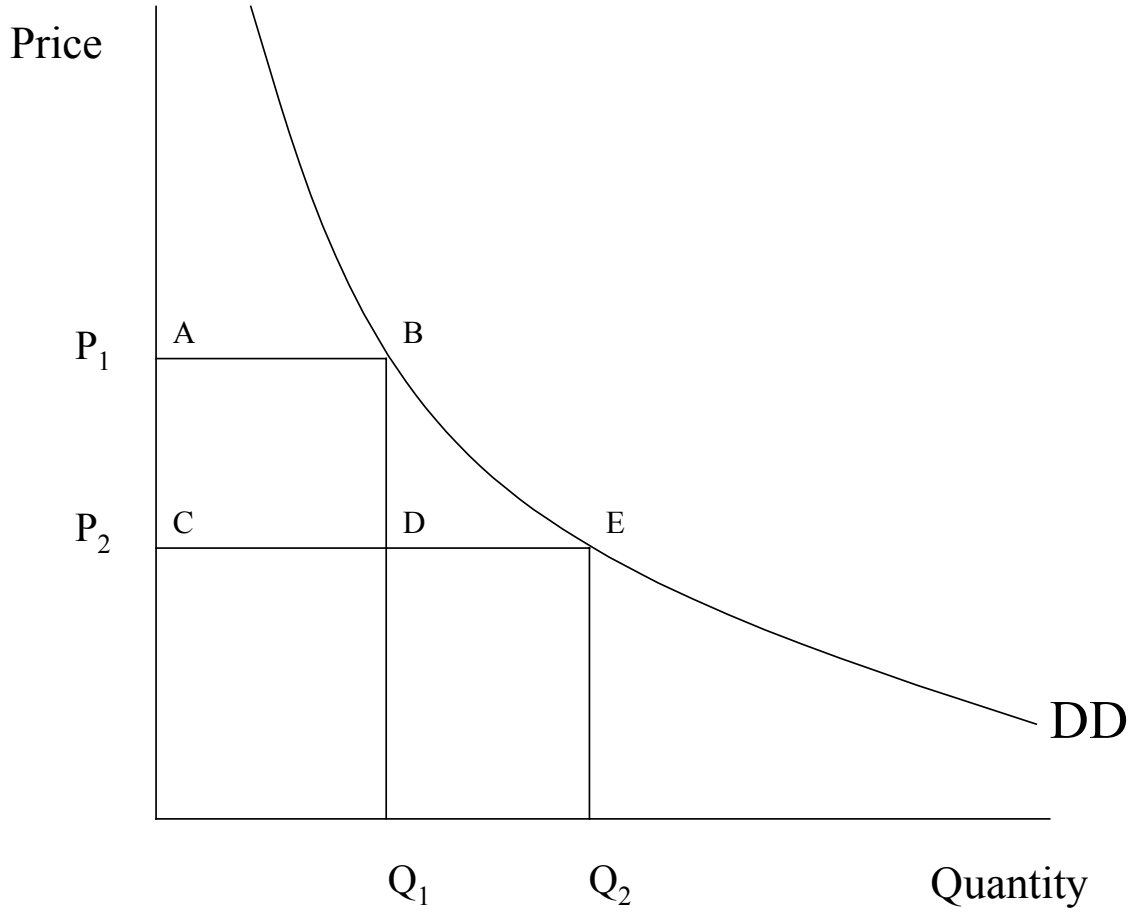
Consumer surplus is a common measure of the economic benefits to consumers from purchasing a particular product above and beyond the price they pay for the product. To define it, one assumes that consumers place a value on each product that they buy. For example, a consumer may decide that a flight from New York to Amsterdam is worth €1,500. If the flight only costs the consumer €1,000, then the consumer is said to realise a "surplus" of €500. This represents the difference between the amount the consumer was willing to pay for the product and the amount that was actually paid. Different consumers on the plane will place different valuations on the flight (and have paid different prices for it), and will realise different consumer surplus values. The total consumer surplus associated with the flight is simply the sum of the consumer surplus values of all the passengers.

The concept of consumer surplus is most often used to measure how much a consumer benefits or loses when the price in a market changes. Continuing the example from above, if a consumer only had to pay €800 for the flight from New York to Amsterdam, the consumer "gains" an additional €200 of surplus.

Calculations

To measure the change in consumer surplus, a graphical representation is easiest to follow. In Figure 38, the demand curve for fares and volumes on a given route is represented by the curve *DD*. The initial price and quantity are represented by (P_1, Q_1). If the price falls to P_2, the new quantity is Q_2. The area above *AB* represents the original consumer surplus, while the new consumer surplus is the area above *CE*. The change in consumer surplus is therefore *ABEC*.

Figure 38



The change in consumer surplus has two components. First, existing passengers enjoy increased surplus if the price they pay is reduced. The area *ABDC* represents the consumer surplus to existing passengers. Second, the price reductions stimulate additional traffic, and each new passenger enjoys a surplus, which is the area *BED*.

In order to calculate the change in consumer surplus, we need to first know the functional form of the demand curve. For the purposes of the study, we have assumed a "constant elasticity of demand" function of the form

$$Q(P) = kP^{-\varepsilon},$$

where P is the price, Q is the quantity, ε is the elasticity of demand, and k is a constant.

To "calibrate" this functional form, we use prices and quantities from industry sources and the US Department of Transportation T-100 International Databank. The economic literature provides estimates of the elasticity of demand for air transportation.[49] Using the observed values of P and Q, and the assumed value of ε, we then calibrate to the data to derive an estimate for k. Once the value of k is obtained, it is then possible to

[49] See footnote 36. Note that the results we present throughout the text for the case where the elasticity is 2.5 are not two and one-half times the results when the elasticity equals one because we are exponentiating to get the results.

calculate the change in consumer surplus associated with a specified change in quantity (*i.e.*, passenger volumes).

In Section 7 we have calculated the change in consumer surplus. We start with the observed prices and quantities (P_2, Q_2) and the assumed demand elasticity ε, which allows us to derive k. Then, we divide Q_2 by 1.51 (based on the estimated 51 percent increase in passenger volume attributed to Open Skies in Chapter 4) to obtain Q_1. With this value and our prior information, we can then derive P_1. In turn, this allows us to calculate the change in consumer surplus, as represented by the area, *ABEC*, in Figure 38.

Actual Calculations

In practice, what we have done is taken the integral of the demand (or inverse demand) curve between P_1 and P_2. This is the precise way of calculating the area of *ABEC*. Once we obtain this value, we can calculate *ABDC* by multiplying Q_1 times the change in price P_1-P_2. This is the change in consumer surplus to pre-existing consumers, and subtracting this value from total consumer surplus gives us the consumer surplus to the new travellers on the route.

We have calculated the consumer surplus for each route separately and then summed the consumer surplus for each route to get the total market change in consumer surplus resulting from Open Skies. These are the estimates we present in the text in Section 7.

The example below shows how we calculated the consumer surplus on the routes from Schiphol to Detroit, Minneapolis, and New York. The fares we had were uni-directional, while the volume figures were bi-directional. We took the fares in both directions (*i.e.*, from the two possible origin points of the city pair) and averaged them to obtain a single fare. That fare was matched with the volume for the route.[50] Then, we applied the estimated increase in traffic to the volume to get the new value of Q_1. We calculated k, used this to calculate P_1, and then calculated the change in consumer surplus using the formulae derived below. Table 19 shows the values used in the calculation on the Schiphol-Detroit, Schiphol-Minneapolis, and Schiphol-New York routes, assuming an elasticity of 1.

[50] We would obtain the same final estimate of consumer surplus by taking the total volume on the city-pair route and assuming half the volume originated at each city.

Table 19

Example of Predicted Increase in Consumer Surplus
Due to Open Skies
Only calculated for routes where volume is available and bidirectional fares are available

Route	*2000 Predicted Fare (P_1)*	*2000 Predicted Volume (Q_1)*	*2000 Actual Volume (Q_2)*	*Calculated "k" Factor (k)*	*2000 Actual Fare (P_2)*	*Gain in Consumer Surplus*
Detroit - Amsterdam	1,088	610,682	924,701	664,146,043	718	275,549,971
Minneapolis - Amsterdam	1,119	316,788	479,684	354,478,406	739	147,070,837
New York - Amsterdam	1,075	647,674	980,715	696,510,654	710	288,977,843

Note:
Assumes elasticity = 1.0

Formulae for Calculating Consumer Surplus

In this section, we present the calculations for the change in consumer surplus assuming a change in price from P_1 to P_2. The change in P can be calculated by determining the price change needed to generate the volume changes estimated in Section 7.

$$CS = \int_{P}^{\infty} kz^{-\varepsilon} dz$$
$$= \frac{1}{-\varepsilon+1} kz^{-\varepsilon+1}\Big|_{P}^{\infty}$$

If $\varepsilon>1$, then

$$CS = -\frac{1}{-\varepsilon+1} kP^{-\varepsilon+1}$$
$$= \frac{k}{\varepsilon-1} P^{-\varepsilon+1}$$

The change in consumer surplus can be calculated by evaluating the consumer surplus at the two different price levels and then subtracting the two values:

$$\Delta CS = CS\Big|_{P_2} - CS\Big|_{P_1}$$

If $\varepsilon>1$, then

$$\Delta CS = \frac{k}{\varepsilon-1} P_2^{-\varepsilon+1} - \frac{k}{\varepsilon-1} P_1^{-\varepsilon+1}$$
$$= \frac{k}{\varepsilon-1}\left(P_2^{-\varepsilon+1} - P_1^{-\varepsilon+1}\right).$$

If ε=1, then

$$Q(P) = \frac{k}{P}$$

$$\Delta CS = \int_{P_2}^{P_1} \frac{k}{z} dz$$

$$= k \ln(z) \Big|_{P_2}^{P_1}$$

$$= k\left(\ln(P_1) - \ln(P_2)\right).$$

By using these formulae, and the values for k, ε, and P, we are able to calculate the change in consumer surplus.

Appendix III: Direct and Indirect Economic Effects

Total Direct and Indirect Requirements per Dollar of Air Transportation

Industry Number	Input Industry	Direct Output Shares	Direct and Indirect Output Shares
12	Maintenance and repair construction, including own-account construction	0.00203	0.01885
26B	Other printing and publishing	0.00116	0.01005
31	Petroleum refining and related products	0.08735	0.09614
43	Engines and turbines	-	0.00049
51	Computer and office equipment	0.00003	0.00411
60	Aircraft and parts	0.02850	0.03421
65D	Air transportation	0.56218	1.01307
65E	Pipelines, freight forwarders, and related services	0.08535	0.12105
66	Communications, except radio and TV	0.01045	0.02266
69A	Wholesale trade	0.01550	0.03521
73A	Computer and data processing services, including own-account software	0.02072	0.03852
73C	Other business and professional services, except medical	0.01613	0.04190
73D	Advertising	0.01259	0.00490
80	Noncomparable imports	0.07415	-
	Total Multiplier	1.00000	1.84498

Sources:
Table 3.-Commodity-by-Industry Direct Requirements, 1996, Survey of Current Business (January 2000): 66-72.
Table 5.-Industry-by-Commodity Total Requirements, 1996, Survey of Current Business (January 2000): 80-86.
Note: The Direct Output Required for Air Transportation includes the Value Added in the industry. This is estimated to be 0.50133. This value added is allocated between capital and labour.

The "direct" requirements are the inputs that are directly needed to produce an additional euro of air transportation. For example, if it takes €0.50 of aircraft parts to directly produce €1 of air transportation, then aircraft parts will have a direct input share of 0.50.

The "indirect" requirements take into account the interactive nature of changes in output in industries that are mutually dependent. For example, if may take €0.50 of aircraft parts to directly produce €1 of air transportation, but it also may take €0.05 of air transportation to produce €0.50 of aircraft parts. In turn, it would take €0.025 of aircraft parts to produce the €0.05 of air transportation, which would require even more air transportation services, and so on.

The "direct and indirect" shares capture the above interactive effects. In essence, these shares represent the impact on each industry's output when the final demand for air transportation is increased by €1. This effect is determined by allowing the final demand for air transportation to increase by €1, and then "rebalancing" the economy so that the quantity produced equals the quantity consumed of all potential inputs into air transportation. These values, reported in Table 5 of the US Input-Output Accounts, are shown in the above table. As mentioned in the text, since a €1 increase in air transportation demand creates more than €1 of overall economic output, the shares add up to a number in excess of one.