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The phenomenon of airline deregulation

The influence of airline deregulation on the number of passengers

Han Shun Lin
Student number: 295194

Thesis Supervisor: P. van Reeven (Erasmus University Rotterdam)
Erasmus School of Economics
Department of Applied Economics

Abstract:

The deregulation of the air market was responsible for less regulatory rules in the air industry and is often assumed to be accountable for the increase in the number of passengers. However deregulation did not seem to have a significant effect on air traffic.

Using a panel of 20 wealthy countries worldwide, this thesis will illustrate that the increasing GDP per capita had more effect on the air traffic than the implementation of deregulation; a higher income was more significant for the increase in air passengers. Consumers became wealthier and could therefore travel/spend more, which can also be seen in other industry with a technical nature. Such markets with high-tech backgrounds are often impacted by economical increase and additional technological developments and awareness. Similar developments could be seen in these typical technical industries such as the car industry, television- and mobile phones industry, where the market output grew when income increased.

In addition, the increase in population seems to have no significant effect on air traffic. The change in population is mostly determined by newborn babies and an older generation that pass away, both niche groups that hardly travel.

Deregulation should be merely regarded as a change or development of the air market. The air market already experienced a gradually increase in passengers many years before deregulation was even implemented. Hypothetically, if there would be no deregulation, the air market would likely still have seen a steady increase in the number of air passengers.

Table of Contents

Chapter 1: Introduction

The air market has experienced many different cycles and processes of deregulation in the 1970s & 1980s and simultaneously it experienced a gradual increase in air traffic. Deregulation changed the air market; less stricter rules about airfares and routes, privatization of airlines and new carriers entered the market, most notably the so-called low-cost carriers (LCC).

With all these changes and developments in the air market, it is often assumed that the deregulation had a massive influence on the number of passengers. However the market did not experience an instant increase in air passengers, but more of a continuation of the gradual increase that was already happening. Therefore, it is likely that there were other factors involved that influenced the air market. In addition, the air industry is a very technical-advanced market where new innovations and developments notably improved the market. This resulted in better equipments/technology which reduced the costs and ultimately improving the market. Furthermore, in the past air traffic has shown a tendency to be very price elastic. This was very clear after the huge Asian Crisis in 1998 where in several countries air traffic decreased more than 20% in 1 year. (World Bank) Also in the recent 2008-2009 financial crisis many countries all around the world saw a significant decrease in the number of passengers. This suggests that income/GDP per capita has an effect on air traffic.
Therefore the problem statement is:

Did deregulation legitimately have an effect on the number passengers?

The number of passengers increased gradually each year, but can the increase of passengers be attributed to the effects of deregulation? This paper will approach the problems as follows, First a background information with relevant literature review. Secondly, annual data for air traffic and GDP per capita measured in constant prices from 20 wealthy countries have been collected from the World Bank and OECD respectively. Furthermore, annual data for

population of al 20 countries are collected as population determines the possible consumer market in the air industry and therefore could have influence on the number of passengers. Subsequently a panel data analysis will be performed with the 20 wealthy countries around the world that all went through different processes of deregulation.

Several indicators are chosen to test the influence on air passengers with the number of passengers (PAX) as the dependent variable. Other independent variables are GDP per capita, population and regulation.

Additionally, this paper is divided in several chapters, first a literature review about deregulation in different regions and the effect on its respective air market. It will explain the history of airline deregulation and how it changed the market. What follows is a methodology explaining the data collecting which will be thoroughly explained in chapter 3. Furthermore there will be analysis of the results of the panel data in chapter 4 and it will end with a final conclusion.

Chapter 2: Literature Review

This Chapter provides a literature review including an overview and history of the air market on how the deregulation started in the United States and how it influenced many other countries around the world. Furthermore the process of liberalization in different countries and regions around the world will be thoroughly explained.

2.1 History

The air market was traditionally an industry that was subsequently regulated and controlled by the government. It was a new technological phenomenon in the early years of the 20th Century and the government insisted to have a bigger role in the airline industry in order to avoid a disorganized market and to have better control of the safety rules as many air accidents were reported at the beginning of air industry. (Sinha, 2001, Pitt & Norsworth, 1999, Graham 1998 & Winston, 2009)

The aviation market started in mail delivery service and the first regular passenger service started in 1925. Also in this year, the US government implemented the 'Air-Mail Act' and the 'Air Commerce Act' in 1926. With these acts the government strived to gain more control over the air market, which was still a new and upcoming industry at the time. Aircraft operators grew from 13 in 1926 to 30 in 1930. (Winston, 2009)

Northwest was one of the operators that came to rise because of the Air Mail act. It started in 1926 as a mail carrier and began carrying passengers in 1927. Another airline that started around the Acts was Delta Airlines. It began in 1924 as an agricultural commercial airline specializing in crop dusting. They started carrying passengers in 1929, but still continuing their agricultural divisions because revenue from passenger flights were still very low and new routes were added extremely slow, often just one or two new routes were added each year. They also began carrying cargo in 1946 and eventually abolished the agricultural division in 1966, as it was not that profitable anymore and the market for passenger flights was drastically growing. (Pitt & Norsworth 1999, Winston, 2009)

In 1938 the US government implemented the Civil Aeronautics Act, which is regularly seen as the "real foundation" of government regulations in the US. In this year they established the Civil Aeronautics Board (CAB), an organization to regulate routes, entry & exit in the air market and other services such as fares, air traffic rules and aircraft registrations and certifications of pilots. The CAB determined 16 new operators in the market in 1939 and no new certifications were given after 1939. (Sinha, 2001)

2.2 Effects of Regulation

2.2.1 Protected Routes & Fixed Prices

The Aircraft operators had their routes protected and air fares were fixed by the CAB. Also airlines were required to invest a part of their profit in feeder routes in rural areas. The government wanted to provide equal air service for all people, also for the people in the rural areas. Since prices were fixed by the CAB, it was important to fill up as many seats in the airplane as possible in order to increase profits. Air carriers competed with special services including meals and beverage to attract customers since they could not compete in air fares. However the non-price competition to attract potential customers between airlines led to excessive spending in other departments and therefore increased the airline expenses. (Good, Roller & Sickles, 1995 & Sinha, 2001)

Controversial moment for the airline industry was the Middle East Oil Embargo in 1973 which drastically increased the oil prices. Airline expenses increased significantly and at the same time the bad economy resulted in huge problems for air operators. The CAB then complied in the demands of airlines to increase the air fares but financially it did not change the situation. Also at the same time, the consumers were very dissatisfied as the air fares were increasing but the services were still the same. A year later in 1974 the government started a research about a possible reform of the air market. Many questions arose about the inefficiency of the air market and the functioning of the CAB. Heated discussions were going on about the high fixed prices and blocking entries of new airlines by the CAB. Additionally, the CAB also did their own internal investigation and concluded that they could not defend

the entry/exit barriers anymore and concluded that the air market is not a monopolistic market but by nature a very competitive market. Both reports from CAB and the government were the first steps to the deregulation act of 1978. (Sinha, 2001)

2.3 Deregulation Effects

2.3.1 Airfares & Routes

Airlines were now able to decide their own air fares and routes. According to Morrison & Winston (1997) the average airfares after deregulation dropped 33% between 1976 and 1993 in real terms. However not all can be attributed to the airline deregulation. Morrison & Winston estimated that at about 60% of the drop, which is about 20% decrease in air fares, can be accounted for deregulation. Furthermore air fares were lower at larger & medium size airports. This can be clarified through competition; there is less competition and travelers at smaller airports and hubs resulting in higher airfares than bigger airports. What also influenced air fares were new innovations and developments in the air market. Better material and new technologies improved the air industry and ultimately resulting in reducing costs. (Pitt & Norsworth, 1999)

2.3.2 Entry of New Carriers

Deregulation opened the air market to new-comers which was also what the government was aiming for. Before the deregulation act, the market acted as a monopolistic market; less competition in a monopolistic market would suggest higher prices and lower output of the market leading to higher costs. (Graham, 1998 & Doganis 1994) Having an increased competition would make the market healthier, obtain better quality of service and ultimately also generate higher profits because the market would become more efficient. Several hundreds of airlines including low-cost carriers entered the market however there were quite a few that did not survive and went into bankruptcy. (Good, Roller & Sickels, 1995 & Schipper & Rietveld, 1998)

2.3.3 Low cost Carriers (LCC) vs. Full Service Carriers (FSC)

The so-called Full Service Carriers(FSC) are airlines who provide a wide range of services, including onboard services; drinks and meals depending on the duration of the flight. Furthermore they have different service classes, pre-flight services such as check-in lines for business class, special waiting lounges and early boarding for regular customers and business class travelers. Additionally after deregulation, more low-cost carriers (LCC) entered the market. They follow a price-leader strategy and the focus is on cost reduction. They provide fewer services both pre-flight and onboard. There are no free drinks and meals on board, no difference in class, and a free seating plan. Also limited baggage is allowed; usually only 1 bag is allowed as hand luggage (10kg) and there is a fee for checking in your luggage. LCCs always attempt to find methods to reduce costs. Moreover, they usually fly with a young and medium-sized fleet, which leads to lower fuel, maintenance, staff costs. These planes have a high-density seating and less toilets so more passengers can board the plane, and thus lower the unit costs. Also LCCs often use smaller, secondary airports who charge lower airport fees. Furthermore, the free seating plan encourages passengers to be on time and board the plane quickly, which makes the boarding process more rapidly and therefore delays can be avoided. (Barret, 2004 & Reichmuch, 2008)

What all LCCs in the world have in common is that they have a similar strategy of cost reduction, fast check-in and quick turn-around at airports. Ryanair has proven to be very successful at smaller secondary airports and Airasia has demonstrated that the concept of low cost is very applicable in the much stricter Asian air market and with limited secondary airports. (Hooper, 1997 & O'Connell & Williams 2005)

2.3.4 Privatization

Many countries also saw their national carrier being privatized as part of deregulating the air market. The table below shows the major airlines from different countries that were privatized in the 1980s & early 90s. However privatization of an airline does not mean that all shares of the company are completely owned by private individuals. Frequently, the government own shares in the airline. Often they are still the biggest shareholder of the air company.

Fig. 1 Airline Privatization

Airline	Privatization
Malaysian Airlines	October 1985
Singapore Airlines	November 1985
KLM	April 1986
Austrian Airways	January 1987
British Airways	February 1987
Japan Airlines	February 1987
Air Canada	October 1988
Lufthansa	September 1989
Air New Zealand	October 1989
Thai Airways	March 1992
Qantas	July 1995

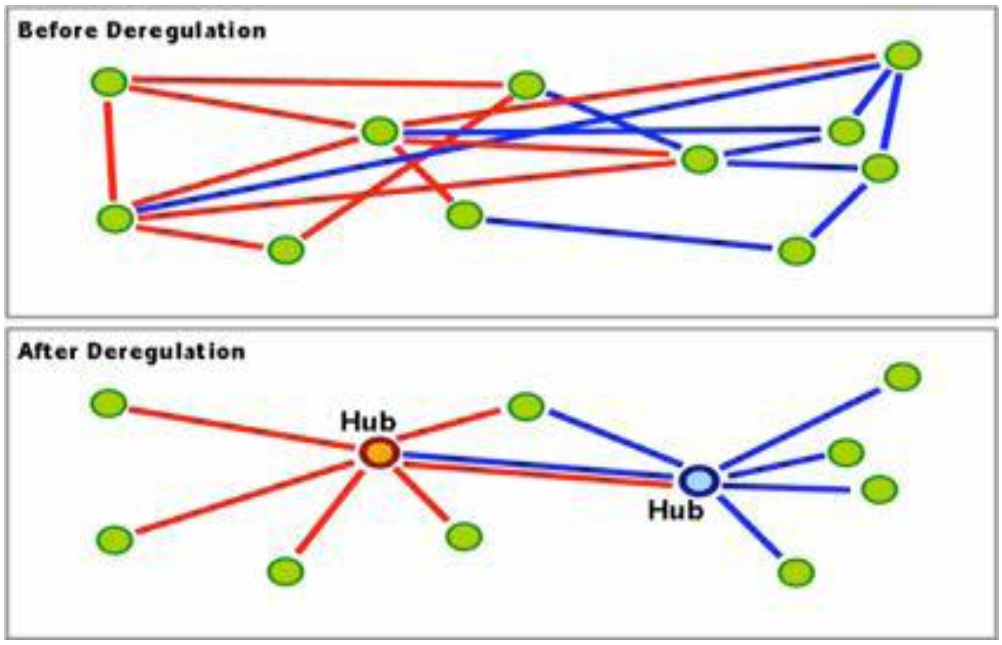
(Source:Al-Jazzaf,1999 & Sinha, 2001)

2.3.5 Hub & Spoke

In order to serve as many routes and as many passengers as possible, the major airlines in the USA changed to a Hub & Spoke strategy. With this strategy, airlines could serve more routes and more passengers than a point-to-point system. This scheme resulted in fewer direct flights and more transfer flights and especially benefited the passengers from smaller airports and hubs as they now would have more connecting flights. Several cities were chosen as main airport where each flight made a stop even though it was not the end point. Passengers could easily connect with many other flights from a hub airport and subsequently get to their final

destinations. An airline with a hub & spoke strategy could therefore, serve more passengers to their final destination with the same fleet size, instead of handling them to other airlines. (Borenstein, 1989, Winston, 2009)

Fig. 2 Before & After Deregulation



Source: the Geography of Transport Systems: Rodrigue, J.P. (1998)

2.4 Deregulation in the United States

The first country where deregulation made its waves was in the United States. The US was always a frontrunner in the air market and the airline deregulation act of 1978 was a turning point in the US air industry.

2.4.1 1978 Deregulation Act

The act abolished many regulatory controls such as restrictions of flight routes, schedules and also the fixed air fares by the government. The air industry changed into in a market-driven industry where consumer demand and the market itself determined the air fares. The CAB was eventually dissolved in 1985 and the remaining responsible duties were taken over by government department of Transportation. One important aspect that remained regulated by

the federation was the air safety. Also they were still responsible for assigning international routes and other services to American air companies. International agreements were made between countries on a bilateral base. Bilateral agreements specified the number of flights they may operate, which cities and how much regulatory authority the government has on air fares. Later in the 1990s the US government also aimed at liberalizing the international routes and in 2000 the US had 45 Open Skies Agreements with different countries. (Graham 1998 & Sinha, 2001)

2.4.2 Southwest Airlines

After the Deregulation act in 1978, several low-cost carriers entered the air market. Acknowledged as one of the leading LCC is Southwest Airlines, who started their business in the state of Texas several years before the deregulation act. Southwest Airlines was established in 1967 but encountered some issues in the first few years. Other airlines that were active in the Texas air market: Braniff, Aloha Air, United Air, Trans-Texas and Continental Airlines were opposed to another airline entering the market, and therefore filed a lawsuit to bar Southwest from entering the market. Eventually the court sided with Southwest and started their first flight in 1971. More legal issues came in 1972 when the cities of Dallas and Fort Worth and the board of the Regional airport forced the airline to move from the smaller Love-Field airport to the new constructed Dallas-Fort worth airport. All other airlines already signed to move to the new airport in 1968, however Southwest was not an active airline back then. The ruling once again was in favor of Southwest when the court allowed the air carrier to serve from Love-Field Airport as long as the airport is still on the market. At the time, Southwest was only active in the state of Texas and it was not until 1979, after the deregulation act, when they began flights out of Texas. (Gittel, 2003) Ever since, Southwest saw a constant growth, was very profitable and outperformed many of their competitors. Currently Southwest Airlines is the biggest airline for the US domestic market in terms of passengers and second in terms of revenue behind Delta Airlines (BTS, 2012)

What made Southwest Airlines exceptional from other airlines is that the service is of good quality, has lower air fares and yet is still very profitable. It was outstanding how Southwest could provide good service for a low price. As a result, the airline has won multiple prices for

good service & quality; a so-called “triple crown” for ‘fewest delays’, ‘fewest complaints’ and ‘fewest mishandled bags’. (Gittel, 2003)

Southwest worked very efficiently and they were an expert in reducing their costs. They already started with their self check-in service on airports in 1979. Also the airline is known for their fast turn-around at airports, which will minimize the time spent at the airport; less time spent on the airport leads to higher revenue. Gittel estimated that even 5 minutes less per departure is already a considerable amount of time to earn higher revenue.

Furthermore the strategy of Southwest was different from the major airlines. After deregulation, the major airlines changed to a Hub & Spoke system which yielded higher revenue per airplane. (Borenstein, 1989) Southwest still applied the regular point-to-point system, though they were very efficient by using a fast turn-around strategy and therefore reaching a high utilization of aircrafts reducing the costs significantly.

The strategy of Southwest Airlines was very efficient and productive and was named the dominant airline in the market in 1993 by the department of Transport. They called it the “Southwest effect” for the reason that whenever Southwest entered a new route/market, other airlines immediately lowered their air fares. (Gittel, 2003)

Southwest continued their dominance in the market even after the terrorist attack in 2001; they were still making profit and only saw a 1.6% decrease in passengers, while other airlines saw much higher decreases in passengers and made considerable losses. (Huschelrath & Muller, 2011 & Gittel, 2003) After 2001, the total number of passengers carried continuously increased, from 72 million in 2002 to 111 million passengers in 2011 and is currently the biggest airline in the US domestic market. (BTS, 2012)

2.5 Deregulation in other regions

In the early years, the air market was often state owned in most countries, but the United States never had government owned airlines at any point in time. However the deregulation in the United States did launch the beginning of deregulation and privatization of the air market and airlines in other countries.

2.5.1 Canada

Canadian Economy is quite similar to the United States and often follows the United States in economic reforms. However the Airline Deregulation was quite different. The first attempt to regulate the air market was in 1984 when the Ministry of Transport announced the "New Canadian Air Transport Policy" when air service was deregulated in the populated South and still regulated in the sparsely populated North. Though, most routes were still served by one or two airlines. (Pustay, 1999 & Mentzer, 2000) Also now air carriers could reduce fares, but increasing the fares was still controlled and could only increase in correspondence with the Consumer Price Index.

Afterwards in 1988 the Canadian government implemented the "National Transportation act" which made the south region even more deregulated but entry barriers were still in practice. Whenever a new airline would like to enter the Canadian market, it had to go through the Canadian Transport Committee. Further, the air routes were liberalized and in 1995 Canada signed an Open Skies Agreement with the United States, which led to an increase in transborder air traffic with 37%. (Sinha, 2001) Also the number of routes to/from the US increased. Before the agreement, Canadian Airlines served 3 routes and it increased to 12 after the agreement. Nonetheless Canada never had the degree of deregulation in the United States, though there were certainly some changes in the market. Air routes were liberalized, reducing air fares was made possible but entry barriers still existed. However Canada did not see the Hub & Spoke strategy being developed. As a big country with a small population, it was not possible to serve such a strategy as air traffic was not sustainable, especially in sparsely populated areas.

2.5.2 Australia & New Zealand

In Australia, the government decided in 1987 that the air market would be better off with a competitive market, and therefore abolished the Airline Agreement Act in 1990. Before 1990 there was a "two airline policy" with trans-Australia (TAA) & Australian National Airways (renamed in 1957 as Ansett Airlines after taken over by Ansett Transport Industries) given the rights to fly to all Australian territories. Additionally there were numerous other regional and commuter airlines, but were only allowed to fly inner state. (Kirby, 1979 & Sinah, 2001) The Australian two-airline policy was deemed successful by Australian politicians as the air market was stable, safety record was good and the airlines had financial stability making consistent profit. However there were also many criticisms towards this policy, arguing the prevention of other airlines to fly interstate is injudicious and that the two-policy airline in practice acted like a monopoly. (Hocking & Forsyth, 1982) Though, Hocking & Forsyth also argued that the two-airline policy had elements of a competition as both airlines had flights from origin to the same destination departing around the same time.

Major changes were realized in the early 90s, the beginning of the deregulation. In 1990, besides the two airlines, there were 45 other regional & commuter airlines. (Sinha, 2001) Many mergers and take-overs occurred after 1990, though many of the 45 airlines already had links and relations with either Australian Airlines or Ansett Airlines through equity shares. In addition, regulatory rules were terminated and all air carriers could fly interstate and could compete with air fares. The domestic travelers increased significantly as Origin-Destination passengers grew 66% from September 1990 to Dec 1991. (Bureau of Transport & Communication Economics, 1995) Also passengers on the main interstate routes increased from 1.8 million to 2.8 million in the same period. Though, unlike the US there was not a big influx of new air carriers in Australia. Additionally, airfares decreased in the first two year on almost every route, except for Canberra-Sydney. Overall, the deregulation has increased intermodal competition and price competition. However, same as Canada and unlike the United States, Australia did not develop a Hub & Spoke strategy. Mainly because Australia has a much smaller population than the US and 90% of the population lives in the five major metropolitan areas which makes all other areas too sparsely populated for sustainable air traffic. (Sinha, 2001 & BTCE, 1995)

New Zealand followed Australia in the late 1980s with deregulation and similar effects happened in New Zealand. As both countries have small populations, it was only more natural to work together and combine the air markets to provide a better service to passengers. Mergers and takeovers between both Australian & New Zealand's airlines occurred in the early 90s and from 1992 all carriers, from both countries were allowed to fly between Australia & New Zealand.

2.5.3 Asia

Asia is the biggest and most populated continent in the world and the airlines are known for their great quality and service. In 2011, all 7 airlines that were rated with a 5-Star ranking by Skytrax, were Asian air carriers. (Skytrax) The Asian aviation market experienced a significantly growth in the 1970s and Taneja (1988) presented a number of factors that were responsible for this growth. First and most important element was the high economic growth in Asia combined with the large population. Also Asian airlines had much lower costs and could therefore provide better services to the travelers and airlines and their home governments cooperated together in good confidence.

In Japan, The air market grew drastically from 1.63 million passengers in 1970 to more than 50 million in 1980 and eventually more than 100 million in 1998. (World Bank) Japan experienced their highest relative increase in the 1970-1980 period, many years before any deregulation was implemented. As the air travel increased significantly during the 70s & 80s and because of the deregulation processes in the US and Canada, the Japanese market was also pressured to make some substantial changes. The market was strictly regulated concerning fares & routes and was very comparable to what the CAB did in the United States.

The Ministry of Transport began a study on how to change the air market and in 1986 came with the following recommendations: Total privatization of Japan Airlines (JAL), no monopoly position for JAL in international flights and allow new carriers to enter to increase competition on domestic routes. (Sinha, 2001, Yamauchi & Ito, 1996) The government partly accepted the recommendations, JAL became privatized in 1987 and lost their monopoly position in the international market and All-Nippon-Airways (ANA) began international flights. However entry to the market remained strictly regulated. Additionally air fares were

also regulated until 1996 when air carriers were allowed to offer discounts up to 50% from the minimum price and in 2000 the first low-cost carrier Skymark, entered the Japanese market.

South-Korea saw a similar increase in passengers in the 1970s as in Japan. From 1.2 million passengers in 1970 to 35.5 million in 1997 but then a huge decline to 27 million in 1998 because of the huge Asian Crisis. (Worldbank) The entry to the market was strictly regulated by the government and until 1988 Korean Air had a monopoly position as it was the only airline active on the market because of the Korea Aeronautics Law. This law stated that new entries were only allowed:

- when it is in the public interest
- justified by market demand
- complied to flight safe standards
- the new airline management is competent

(Kim & Ha, 2000)

In 1988 Asiana Airlines entered the market because the market demand increased and also because there was a worldwide trend of deregulation. South-Korea turned from a monopoly to a duopolistic market. Moreover, air fares were not determined by the Government anymore, however any price change still had to be approved by the government, so effectively nothing changed. Same procedure was applied for air routes; any route could be served but first had to be approved by the government. It was not until 2005 when Jeju Air, the first low cost carrier entered the market and subsequently in 2008 Korean Air started their own low cost airline with Jin Air.

Other Asian countries have also experienced some levels of deregulation in the air markets. India, the second most populated country in the world, was a monopoly by the government until 1991. Both Air India, serving the domestic routes and Indian Airlines, flying international routes, were government owned. From 1991 onwards there were several changes in the market. New carriers were allowed to enter the market, foreign investments/ownership was allowed.

Indonesia, the 3rd most populated country of Asia, originally had two major airlines and served both the domestic and international market. However, the country exist of thousands islands and therefore it also had 3 smaller privately owned airlines who flew domestically. In 2000 7 new privately owned airlines entered the Indonesian domestic market.

Malaysia had a monopolistic market with Malaysian Air as the national carrier. In 1975 Sabah Air a small private company started their services and two more small privately owned airlines entered the market in 1980s and in 1985 Malaysian Air became (partially) privatized. Furthermore Malaysia is the home base for the well-known Airasia. It started unsuccessfully in 1996, but it had a second start in 2001 and eventually became the biggest low-cost carrier of Asia. (Hooper, 1997, Kim, 1996, Kim & Ha, 2000, Yamauchi, 1997, Sinha 2001)

Airasia has a lot of similarities with Ryanair and the CEO is even a former director of Ryanair. Also both Ryanair and Airasia began as loss-making companies before turning into profitable airlines. Airasia is very efficient; their operating cost per km is the lowest for any airline in the World. (Hooper, 1997 & Sinha, 2001)

Despite that Asia is far behind the level of deregulation in Europe or North-America, Airasia has proven that the LCC concept is still possible in a less deregulated and stricter market. (Hooper, 1997 & O'Connell & Williams 2005) The LCC concept started much later in Asia and with Airasia's success, several new Asian LCCs entered the market, such as Tiger Airways Singapore and Jeju Air Korea.

Overall, there are some Asian countries that experienced a certain level of deregulation but all far behind the degree of regulation in the US, Canada or Australia. The air market did however see an enormous growth in passenger travel in the 70s and 80s, many years before there was any deregulation in the air market. This already shows that there were other factors involved that influenced the number of passengers. Also several Asian countries experienced a huge drop in air traffic after the big crisis in 1998. This also suggest that demand is very price elastic and is more dependent on income/GDP per capita; higher income leads to more air traffic.

2.5.4 Europe

Regulatory Changes in the US, Canada, Australia and other countries have very likely influenced the deregulation in Europe. However Europe was fairly late in liberalizing the air market. Essentially the European case is very complicated because it involves many different countries and governments. Whereas regulation changes in the US, Canada and Australia was all in 1 single country, their own government and mainly the domestic market. (Sinha, 2001)

Traditionally air transport has been very highly regulated in Europe. Most countries have their own national airline and often they hold exclusivity to fly in their respective countries and all other independent airlines were excluded. Market Capacity and the division between airlines were decided in advance and fares were determined by the Airlines in cooperation with the government. (Barrett, 2009) However this system was criticized as it resulted in high fares and also higher cost for air carriers. In fact, the air fares in Europe have always been the highest in the world. According to ICAO, in 1990 the average price for a 250km flight in Europe was 0.70 USD per km, much higher than the worldwide average of 45 cents.

Fig. 3 Price in US cents per km Source: ICAO, Annual Survey of Air Fares (1990)

Region/Distance	250km	500km	1000km	2000km	4000km
World(Average)	45.1	35.5	28.0	22.1	17.4
North/Central America	46.3	32.2	22.5	15.6	10.9
Central America	34.5	25.3	18.6	13.6	-
North America	39.7	27.9	19.6	13.8	9.7
North/South America	21.2	18.4	16.0	13.9	-
South America	22.9	19.6	16.8	14.4	12.3
Europe	70.0	51.8	38.4	28.4	21.0
Middle East	33.2	26.4	21.9	16.7	15.4
Africa	31.1	26.1	21.9	18.4	15.4
Europe/Middle East	-	27.3	25.0	22.8	20.9
Europe/Africa	-	26.2	23.6	21.3	19.2
Mid-Atlantic	-	-	-	-	20.7
South Atlantic	-	-	-	-	14.5
Asia/Pacific	20.8	19.1	17.5	16.1	14.7
Europe/Asia/Pacific	-	-	13.7	13.9	14.0
South Pacific	-	-	-	-	15.7

The cause of high airline costs in Europe

Studies from the Civil Aviation Authority (CAA) and the Association of European Airlines (AEA) in the early 1980s have shown that airline costs in Europe were significantly higher than North America. In the report from the CAA (1983) it was stated that European Airline costs are 98.5% higher than North America. The study divided the costs in sales & ticketing (22.9%), route & landing charges (18.3%), Station & Ground costs (13.8%), fuel & oil costs (13.4%) and Crew (11.2%). Additionally the study from AEA (1984) also reported that the European Airline costs were significantly higher at 74%. Also here, Sales, Ticketing & Promotion accounted for the highest cost at 26.8% of total airline costs. Other Costs were: Landing charges (24.2%), Station & Ground Costs (12.3%), cabin services (9.7%), maintenance & overhaul costs (9%) and fuel & oil costs (8.7%).

In both reports Sales Costs were the highest. Higher sales cost means that European airlines have lower staff productivity. Staff costs in 1989/1990 were more than 5 times as high as in North America. (Doganis, 1996) Also the landing & route charges were much higher in Europe then North America. Barrett argues that the main cost difference is in how the airports are managed and financed. American airports obtain a higher income from non-aeronautical activities, such as shops, restaurants, car parking etc. Whereas European airports did not engage much in commercial activities and the higher airport charges for airlines were regained through higher airfares.

Fig. 4 Staff Productivity of European Airlines

Airline	T-km per staff	Airline	T-km per staff
Austrian	77,000	KLM	178,000
Sabena	142,000	TAP	82,000
Air France	138,000	SAS	116,000
UTA	173,000	Iberia	90,000
Lufthansa	172,000	Swissair	132,000
Olympic	70,000	British Airways	115,000
Aer Lingus	68,000	Dan Air	130,000
Alitalia	152,000	Virgin	352,000
		Average/Total	120,000

Fig. 5 Staff Productivity of North American Airlines

Airline	T-km per staff	Airline	T-km per staff
Air Canada	149,000	Pan American	204,000
American Airlines	150,000	American West	139,000
Canadian Airlines	152,000	Hawaiian Airlines	177,000
Eastern Airlines	139,000	Midway	142,000
Delta Airlines	152,000	TWA	181,000
Continental Airlines	145,000	United Airlines	188,000
Alaska Airlines	79,000	US Airways	110,000
Northwest Airlines	282,000	Average/total	164,000

Source: ICAO, Civil Aviation Statistics of the World (1991)
(*For more detailed tables see Appendix I*)

Sources from ICAO shows that North American Productivity was on average 36.7% higher than in Europe, measured in Ton/Kilometer including freight, air- mail and passengers per km. (ICAO, Civil Aviation Statistics, 1991) An average weight of 90 kg was taken for passengers including luggage to calculate the Ton/Kilometer. Ton/kilometer for Passengers was then obtained by multiplying the number of passengers by 90 kg. The tables above show the Ton/Kilometers per staff member for European and North-American Airlines in 1990.

Liberalization process in Europe

The process of liberalization in Europe was far more complex than other regions as it involved many different countries and governments who all had their own vision of what would be good for the air market. Therefore, the liberalization was implemented at a much slower pace and took place in stages. France and the Mediterranean countries were in favor of a more restricted regime, while the United Kingdom and the Netherlands, who both had their national carriers being privatized in the 80s, were for a more open market. (Sinha, 2001 & Good, Roller & Sickles, 1993)

In addition, the European air market differs with the US market as it contribute mostly to international flights whereas in the United States, the most dominate part of the aviation

market is the domestic market. In 1990 52.9% of the departures and 55% of the total passengers in Europe involved international flights. While in the United States only 15.4% of the departures and 8.9% of the total passengers belonged to the international market. (Sinha, 2001 & Encaoua, 1992)

The process of liberalization started as early as in 1979, when a study from the European Commission recommended a liberalization of the European aviation market including the need to offer cheaper fares, an easier access to the air transport market and stricter rules for subsidies. However most European countries rejected this plan, because what hindered the process was that most airlines were subsidized and were often (partly) government owned through equity shares. The national carriers were subsidized to circumvent cases of operating loss, provide services in underdeveloped/sparsely populated areas and also to acquire certain airplanes. (Graham, 1997)

It took several years before the first phase of liberalization took place in Europe. In 1986, ministers from different countries began discussing an agreement to liberalize the aviation market. Subsequently a first step towards liberalization was implemented in 1988 with a lesser amount of competition rules and reduced price controls; discount fares were now automatically approved. The next step in 1990 was when a so-called double-disapproval scheme was implemented. This specified that air fares could only be prohibited when both countries of Origin & Destination disapproved the fare with valid reasons.

A final stage of liberalization happened in 1997 when all airlines from the European Union had access to all possible routes within the EU. Furthermore the carriers were free to operate domestic services in every country regardless of where the home base is situated. This included flying to another country to pick up passengers and then continue to another country. Also fares were now decided by the airlines however the EU still had the possibility to intervene in suspected cases of excessive pricing and cartels. (Good, Roller & Sickles, 1993, Doganis, 1994, Graham 1997 & Sinah, 2001)

Ryanair & Easyjet:

With the deregulation in Europe several new low-cost carriers entered the market, most notably Ryanair & Easyjet. Ryanair is an Irish airline established in 1985 and is currently the biggest LCC of Europe carrying 74 million passengers in 2010. (Worldbank, Ryanair, Annual Report 2011) Passengers total has been increasing rapidly from 7 million in 2000 to 74 million in 2010. They followed a similar strategy as Southwest in reducing their costs and could therefore offer much cheaper air fares then their competitors in Europe. One important aspect of Ryanair's strategy is to use smaller, underused, secondary airports where airport fees are lower and less airport congestion. Moreover Ryanair handles their check-in and boarding very rapidly as they have free-seating in the airplane. Another quality from Ryanair is that as a service to their customers, it does not overbook their flights with the usual 2-3% as other (major) airlines. Also just like Southwest, they have a quick turn-around point at airports, which would be impossible at bigger European hub airports. (Barret, 2004) Furthermore, the airline is also the most productive airline of Europe with 10,050 passengers per staff member, more than No.2 Easyjet (6293 per staff member) and No.3 Aer Lingus (1520 per staff member). (Sull, 1999)

Ryanair's biggest competitor is the UK based Easyjet, a LCC established in 1995 and is currently biggest airline of the UK in terms of passengers. (Worldbank) Passengers increased rapidly from 1.7 million in 1998 to 56 million in 2010. (Worldbank & Easyjet Annual Report, 2011) It follows a similar strategy as Ryanair, focusing on reducing costs, quick turn-around etc. Though there is 1 important distinction that Easyjet is not only exclusive to smaller secondary airports, but flies to several bigger hub airports including Amsterdam Schiphol Airport.

Concluding Remarks Literature Review

As shown in this literature chapter, many different countries in the world have experienced a certain degree of deregulation. In some countries the air market saw some huge changes and many regulatory rules were abolished. Other countries saw some less severe changes in the air market. However most countries did not see a spike increase in passengers, but more of a continuation of the gradual increase that already was happening.

Chapter 3: Model & Data

3.1 Methodology

This chapter provides a model to study the influence of deregulation on passenger air traffic. Data is collected from official institutions the World Bank & the Organization for Economic Co-operation and Development (OECD). The statistical tool used for this study is STATA.

A panel data analysis is used for this research. This will allow you to control for other factors that have simultaneously effect on the dependent variable which is important for both testing economic theories and evaluating the various deregulation effects on air traffic.

Formally this model can be written as:

$$PAX = f(G, P, D)$$

Where PAX is the number of passengers, G is GDP per capita, P is population and D is deregulation.

This model provides a Panel of 20 wealthy countries with annual data for the time period 1970-2010. This specific time frame is chosen because it includes different phases of the airline industry containing both periods of before and after deregulation. With a panel data, the model can be corrected for unobservable time-invariant effects, correlated to other variables.

The 20 countries chosen for this research are the USA & Canada (North-America), Australia (Oceania), Japan & South-Korea (Asia), Austria, Belgium Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Spain, Sweden, Portugal and the United Kingdom (EU-15). These countries were chosen because they all went through a process of deregulation at different levels.

3.2 Explanatory Variables & Additional Literature Review

In order to study the influence of airline deregulation, several indicators are used as explanatory variables. The number of passengers is the dependent variable since the research is on the influence of airline deregulation on air traffic. Other independent variables are GDP per capita and population and deregulation.

The GDP per capita is one of the most used indicators to measure the level of total output and income relative to the population of a country or region. A higher GDP per capita is positively correlated to total output, which means that a higher GDP per capita reflects a better well-being and economic health. (Laezer & Gibbs, 2007) Therefore an increase in GDP per capita leads to a shift in the income elasticity of demand c.q. a higher income leads to a higher demand of luxury goods. Consequently air travel is considered a luxury good and the income elasticity of demand is higher than 1, which means the demand for air travel will increase when income rises. (Rosen & Gayer, 2008)

Population is also one of the tested variables as this is the potential consumer market and therefore could have an influence on air traffic. An increasing consumer market is often positively correlated to a higher output, hence a bigger population could potentially have effect on air traffic (Shaw, 1999, Laezer & Gibbs, 2007 & Rosen & Gayer, 2008)

Furthermore the research is on the influence of deregulation on air traffic therefore the model takes yearly deregulation dummy variables for the year when the deregulation was implemented in the respective countries.

The independent variables are evaluated based on their statistical significance by looking at the p-value. When the p-value is <0.05, it is considered to have a significant effect. Moreover, in order to avoid bias and heteroskedasticity and also to ensure that the dependent variable is normally distributed and to correct for it, the natural logarithm is taken for GDP per Capita, population and PAX.

PAX

The dependent variable is the number of passengers (PAX), PAX data is collected from the World Bank database for 20 countries for the period of 1970-2010. Noticeable was the gradual increase in the number of passengers for all countries in the sample size.

GDP Per Capita

The GDP per capita at constant market prices for the 20 countries is collected from the databank of the OECD. The GDP per capita has been gradually increasing which is in line of with a gradual increase in air traffic. Also the Asian Crisis in 1998 and the Financial Crisis in 2008 resulted in a significant decrease in the number of passengers. Therefore I hypothesize that a positive effect will be seen when income increase and that the influence on air traffic is related to the GDP per capita and not so necessarily to the airline deregulation.

Hypothesis 1: GDP per capita has a significant effect on the number of passengers.

Population

Data for all 20 countries was collected from the World Bank database and it showed that population has been constantly increasing over the years. This means the potential consumer market increased and therefore very likely to have a possible effect on air traffic.

Hypothesis 2: Population has a significant effect on the number of passengers.

Deregulation

For each country there is a dummy variable for the year when the first step to deregulation was implemented. For example the deregulation in the USA started in 1978, so the dummy starts in 1978. The USA, Canada, Australia, Japan & South-Korea all have their own dummy

variable and the 15 European have the same dummy variable as deregulation happened in all the 15 EU-countries. Moreover there is a dummy variable for each year, and subsequently the dummy variables for deregulation are multiplied by the year to correct for long-term effects. In the literature review in Chapter 2 we saw that countries after deregulation did not see a massive increase in passengers but more of a continuation of the gradual increase that already was happening. Therefore the expectations are that deregulation had limited effect.

Hypothesis 3: Deregulation had limited effect on the number of passengers.

3.3 Additional Tests

Unit Root Test

The data was tested for unit root and showed mixed results for some variables. (See Appendix II) GDP per capita is a stationary variable. PAX, however should be a stationary variable, but according to the test results it has a unit root. Population expected to have unit root seems to be a stationary variable.

Hausman Test

Hausman Test
Chi2 =60.76
Prob>Chi2 = 0.0000

Additionally a Hausman Test was performed to test for fixed and random effects and the test resulted in favor of fixed effects. (See Appendix III)

Serial Correlation Test

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
F (1, 19) = 230.401 Prob > F = 0.0000

Moreover a serial correlation test has been performed and there was evidence found for serial correlation. Data which are repeatedly collected over time have a possibility of serial correlation, which means error terms from different time periods are correlated. This means there is a possibility that the results could be slightly biased as serial correlation causes the standard error to be inflated.

Chapter 4 Analysis

In order to analyze the effects of deregulation on the number of passengers, a dynamic panel data analysis was performed with the 20 countries. A dynamic model panel data set was performed to adjust for time elements. The Autoregressive Distributed Lag (ADL) model (ADL, 1, 1) takes the following formula:

$$\gamma_t = \alpha_o + \alpha_1 \gamma_{t-1} + \beta_o X_{t-1} + \varepsilon_t$$

Where γ_t is the dependent variable and α_i are the independent variables. β refers to the coefficients accompanying the independent variables and ε_t is the standard error.

Since the descriptive data contains both stationary and non-stationary data, it is better to use an error correction model which is a linear transformation of the above general ADL model. The following error correction model is derived from a transformation from Bårdsen (1989):

$$\Delta\gamma_t = \alpha_o + \alpha_1^* \gamma_{t-1} + \beta_0^* \Delta X_t + \beta_2^* X_{t-1} + \varepsilon_t$$

The Bårdsen model gives the same information as an ADL model but it can take both stationary and non-stationary data. The model diminishes the problem of collinear regression due to autoregressive variables or unit roots.

Fig. 6 Panel Data Results

R-sq=0.97	Coef.	Std.Err.	P>|t|
D.GDP per cap	0.89	0.26	0.001
D.Population	0.29	0.54	0.593
L. PAX	0.94	0.21	0.000
L. GDP per cap	0.21	0.06	0.001
L.Population	0.22	0.14	0119
Dereg USA	0.00	0.00	0.840
Dereg CAN	0.00	0.00	0.747
Dereg AUS	0.00	0.00	0.451
Dereg JAPAN	-.00	0.00	0.971
Dereg KOREA	-.00	0.00	0.175
Dereg EUR	0.00	0.00	0.159

The analysis shows an R-sq of 97%. This means that by using the chosen independent variables the models explain 97% of the number of passengers. The relevant results for the panel data are shown in the table above. Other dummy variables are omitted. (See Appendix IV for the complete panel data)

GDP per capita has a significant effect on the number of passengers which is in line with the initial hypothesis. The long term effect is that with every 1% increase in GDP per capita, air traffic will increase with 0.21. This means that when people become wealthier they travel more. This also seems legit from an economical point of view as you become wealthier you spend more on luxury goods, a trend which can also be seen in other technological markets such as the car-, television- and mobile phone industry, where the output significantly increased. (Pitt & Norsworth, 1999) Consequently the initial hypothesis that GDP per capita does have a significant effect on the number of traffic is correct.

After assessing the results, population is remarkably not significant to the number of passengers. The primary consent is that when the potential consumer market increase, it will have a positive effect on the output. For the air market the whole population is considered to be a potential customer but an increase population does not appear to be significant to air traffic. This can be clarified by the type of residents that determine the change in population as they are not from a substantial group that travels. The change in population is mostly signified by newborn babies and the older generation that pass away, both niche groups that hardly travel. Therefore the initial hypothesis that population would have an effect on the number of passengers is incorrect.

Furthermore, from the results it can be concluded that deregulation surprisingly had no significant effect on the number of passengers. The reason why it does not have a significant effect on air traffic is that deregulation most likely only facilitated and defined the market and can be merely regarded as an evolvement or a development of the air market, just like any new developed technology or innovation. All countries already experienced a gradual increase in air traffic, years before deregulation was even implemented. Therefore deregulation can merely be seen as change or development of the market.

Chapter 5: Conclusion

Airline deregulation may not have had a significant effect on air traffic, but it certainly facilitated and changed the air market. Deregulation should be perceived as a development or an evolvement of the market. With the nature of market, air traffic would most likely have increased even if there was no deregulation. Gradual increase in the number of passengers happened years before deregulation was implemented. In certain countries such as South-Korea & Japan the highest increase in passengers came before the deregulation even started.

Additionally, population change was not significant to air traffic, which in the first consideration seems surprising as the population is the potential consumer market for airlines. However the change in population is mostly signified by newborn babies and an older generation that pass away, both niche groups that hardly travel.

The aviation market was significantly more impacted by GDP per capita as can be seen from the statistical analysis. A higher income was more significant for the increase in air passengers, which can also be seen in other technological markets. Such markets with high-tech backgrounds are often impacted by economical increase and additional technological developments and awareness. This happened in other similar technical industries such as the car-, television- and mobile phones industry. These markets saw a similar increase in output as the aviation market. The car production increased because of higher income, newer technologies which made producing cars cheaper better engines which lead to fuel cost reduction etc. Also the television and the mobile industry, both hi-tech markets saw a similar outcome. Not many people owned a TV or a mobile phone at the time when the market just started out, but increased significantly over time. This was impacted by economic growth, practical awareness and high-tech developments just like the aviation market. Additionally, the air market also went through a similar process of increasing technological developments. New technology and expertise lead to better equipments, engines and other innovations. These innovations reduced the production- and fuel costs. Ultimately all technological developments reduced the costs and/or improved the market.

To conclude the increase in air traffic was mostly affected by an increase in GDP per capita. People became wealthier and became more aware of the convenience of flying; it was much more time-consuming to travel by train, bus or car. Furthermore, the newer innovations and developments resulted in decreasing costs because of better equipments, for example improved engines which lead to lower fuel costs. Deregulation was helpful to a certain extent, but it must be merely regarded as a development or an evolvement of the market. The gradual increase in passengers already started years before the deregulation. Hypothetically if there was no deregulation, a combination of increasing GDP per capita and continuously new innovations and development would very likely have increased the number of passengers; that is the nature of the industry.

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Appendices

Appendix I Airline Staff Productivity

Airline	T-km per Staff *1,000	No. Staff	T-km (in millions)
Austrian	77	4,128	316
Sabena	142	7,340	1,045
Finnair	138	7,127	981
Air France	173	39,810	6,873
Lufthansa	169	6,787	169
Olympic	70	47,619	829
Aer Lingus	68	11,906	402
Alitalia	152	5,945	2,933
KLM	178	19,348	4,328
TAP	82	24,247	794
SAS	116	9,711	2,564
Iberia	90	22,180	2,587
Swissair	132	28,843	2,542
British Airways	115	19,296	5,769
Dan Air	130	50,008	499
Virgin Air	352	3,843	492
Total	120	300,545	36,037
Average (of 17)	120	17,679	2,120

Airline	T-km per Staff *1,000	No. Staff	T-km (in millions)
Air Canada	149	22,622	3,362
American	150	85,915	12,845
Canadian	152	17,832	2,712
Eastern	139	19,075	2,653
Delta	152	64,791	9,829
Continental	145	33,533	4,857
Alaska	79	5,822	459
Northwest	282	35,775	10,019
Pan American	204	28,823	5,873
American West	139	12,764	1,769
Hawaiian	177	2,808	498
Midway	142	5,171	732
TWA	181	33,189	6,019
United	188	70,179	13,186
US Airways	110	50,464	5,559
Total	164	488,763	80,372
Average (of 15)	164	32,584	5,358

Appendix II Unit Root Test

```
. xtunitroot fisher lnpax, pperron lags(1)

Fisher-type unit-root test for lnpax
Based on Phillips-Perron tests
------------------------------------
Ho: All panels contain unit roots           Number of panels       =     20
Ha: At least one panel is stationary        Avg. number of periods =  40.60

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 1 lag
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(40)   P        37.4626       0.5851
 Inverse normal            Z         2.0720       0.9809
 Inverse logit t(104)      L*        1.9600       0.9737
 Modified inv. chi-squared Pm       -0.2837       0.6117
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

. xtunitroot fisher lngdp, pperron lags(1)

Fisher-type unit-root test for lngdp
Based on Phillips-Perron tests
------------------------------------
Ho: All panels contain unit roots           Number of panels       =     20
Ha: At least one panel is stationary        Avg. number of periods =  40.60

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 1 lag
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(40)   P        55.8058       0.0496
 Inverse normal            Z        -0.6758       0.2496
 Inverse logit t(104)      L*       -0.7514       0.2271
 Modified inv. chi-squared Pm        1.7671       0.0386
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

. xtunitroot fisher lnpop, pperron lags(1)

Fisher-type unit-root test for lnpop
Based on Phillips-Perron tests
------------------------------------
Ho: All panels contain unit roots           Number of panels       =     20
Ha: At least one panel is stationary        Avg. number of periods =  40.60

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 1 lag
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(40)   P       119.1962       0.0000
 Inverse normal            Z        -0.1113       0.4557
 Inverse logit t(94)       L*       -3.2231       0.0009
 Modified inv. chi-squared Pm        8.8544       0.0000
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

Appendix III Hausman Test

```
. . xtreg lnpax lngdp lnpop _I*, fe
note: _Iyear_2011 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       812
Group variable: id                              Number of groups   =        20

R-sq:  within  = 0.8599                         Obs per group: min =        36
       between = 0.8317                                        avg =      40.6
       overall = 0.8110                                        max =        41

                                                F(42,750)          =    109.65
corr(u_i, Xb)  = 0.4710                         Prob > F           =    0.0000

.
.         . estimates store fixed

.
.         . xtreg lnpax lngdp lnpop, re

Random-effects GLS regression                   Number of obs      =       812
Group variable: id                              Number of groups   =        20

R-sq:  within  = 0.8405                         Obs per group: min =        36
       between = 0.8809                                        avg =      40.6
       overall = 0.8706                                        max =        41

                                                Wald chi2(2)       =   4288.50
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       lnpax |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lngdp |   1.838866   .0361779    50.83   0.000     1.767959    1.909774
       lnpop |   1.057152   .0687902    15.37   0.000      .922326    1.191978
       _cons |  -19.92462   1.050299   -18.97   0.000    -21.98316   -17.86607
-------------+----------------------------------------------------------------
     sigma_u |  .46610827
     sigma_e |  .28571128
         rho |  .72688441   (fraction of variance due to u_i)
------------------------------------------------------------------------------

.
.         . hausman fixed ., sigmamore

                ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |    fixed            .          Difference          S.E.
-------------+----------------------------------------------------------------
       lngdp |   1.361034     1.838866       -.4778326        .0706949
       lnpop |   .5864088     1.057152       -.4707434        .2177356
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       60.76
                Prob>chi2 =      0.0000

.
```

Appendix IV Panel Data Results

```
. xtreg lnpax d.lngdp d.lnpop l.lnpax l.lngdp l.lnpop dusat dcant daust  djapant dkort deur1t _I*,fe
note: _Iyear_2009 omitted because of collinearity
note: _Iyear_2011 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       788
Group variable: id                              Number of groups   =        20

R-sq:  within  = 0.9660                         Obs per group: min =        34
       between = 0.9963                                        avg =      39.4
       overall = 0.9880                                        max =        40

                                                F(50,718)          =    408.51
corr(u_i, Xb)  = -0.8520                        Prob > F           =    0.0000
```

lnpax	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lngdp D1.	.8947088	.2630423	3.40	0.001	.3782848	1.411133
lnpop D1.	.2900456	.5423037	0.53	0.593	-.7746449	1.354736
lnpax L1.	.9389947	.0208373	45.06	0.000	.8980853	.979904
lngdp L1.	.2096092	.0639732	3.28	0.001	.0840123	.335206
lnpop L1.	.220529	.1412241	1.56	0.119	-.0567325	.4977906
dusat	6.42e-06	.0000317	0.20	0.840	-.0000559	.0000687
dcant	9.24e-06	.0000287	0.32	0.747	-.000047	.0000655
daust	.0000211	.000028	0.75	0.451	-.0000338	.000076
djapant	-1.08e-06	.0000294	-0.04	0.971	-.0000588	.0000567
dkort	-.0000525	.0000386	-1.36	0.175	-.0001283	.0000233
deur1t	.0000297	.0000211	1.41	0.159	-.0000117	.0000711
_Iyear_1971	.2788142	.0819678	3.40	0.001	.117889	.4397393
_Iyear_1972	.2369258	.0814164	2.91	0.004	.0770831	.3967686
_Iyear_1973	.2523581	.0806353	3.13	0.002	.0940489	.4106674
_Iyear_1974	.1885724	.0766774	2.46	0.014	.0380336	.3391111
_Iyear_1975	.2075483	.0752617	2.76	0.006	.059789	.3553076
_Iyear_1976	.2132613	.0766483	2.78	0.006	.0627798	.3637428
_Iyear_1977	.2192485	.0749186	2.93	0.004	.0721627	.3663342
_Iyear_1978	.2445506	.0735455	3.33	0.001	.1001607	.3889405
_Iyear_1979	.2315854	.0728716	3.18	0.002	.0885186	.3746523
_Iyear_1980	.1172058	.0708513	1.65	0.099	-.0218946	.2563062
_Iyear_1981	.1845124	.0700876	2.63	0.009	.0469112	.3221135
_Iyear_1982	.1857534	.0698533	2.66	0.008	.0486123	.3228945
_Iyear_1983	.163733	.0698197	2.35	0.019	.0266578	.3008082
_Iyear_1984	.1773804	.0693492	2.56	0.011	.0412289	.3135319
_Iyear_1985	.1830541	.068591	2.67	0.008	.0483912	.317717
_Iyear_1986	.1556055	.0680899	2.29	0.023	.0219265	.2892845
_Iyear_1987	.214928	.0663675	3.24	0.001	.0846304	.3452257
_Iyear_1988	.1613817	.0567971	2.84	0.005	.0498735	.27289
_Iyear_1989	.1337145	.0550887	2.43	0.015	.0255604	.2418686
_Iyear_1990	.1468774	.0533849	2.75	0.006	.0420683	.2516866
_Iyear_1991	.0456004	.0521471	0.87	0.382	-.0567786	.1479793
_Iyear_1992	.1535859	.0506667	3.03	0.003	.0541132	.2530586
_Iyear_1993	.1201642	.0500345	2.40	0.017	.0219329	.2183955
_Iyear_1994	.1319862	.0516689	2.55	0.011	.0305461	.2334263
_Iyear_1995	.1443746	.0510439	2.83	0.005	.0441615	.2445876
_Iyear_1996	.1378206	.0500121	2.76	0.006	.0396331	.2360081
_Iyear_1997	.1242797	.0506952	2.45	0.014	.0247511	.2238083
_Iyear_1998	.088314	.0493343	1.79	0.074	-.0085427	.1851706
_Iyear_1999	.0989054	.0501927	1.97	0.049	.0003635	.1974473
_Iyear_2000	.1190155	.0500431	2.38	0.018	.0207672	.2172637
_Iyear_2001	.0365614	.0472625	0.77	0.439	-.0562278	.1293507
_Iyear_2002	-.0354825	.047159	-0.75	0.452	-.1280686	.0571036
_Iyear_2003	.105563	.0467337	2.26	0.024	.0138119	.1973141
_Iyear_2004	.1092674	.0476594	2.29	0.022	.0156989	.2028358
_Iyear_2005	-.047369	.0473888	-1.00	0.318	-.1404061	.0456681
_Iyear_2006	.0630846	.0481414	1.31	0.190	-.0314302	.1575993
_Iyear_2007	.0785504	.0484889	1.62	0.106	-.0166465	.1737472
_Iyear_2008	.0459478	.0467836	0.98	0.326	-.0459011	.1377968
_Iyear_2009	(omitted)					
_Iyear_2010	.240838	.0474812	5.07	0.000	.1476195	.3340565
_Iyear_2011	(omitted)					
_cons	-4.936837	2.276411	-2.17	0.030	-9.406055	-.467619
sigma_u	.22978184					
sigma_e	.13295885					
rho	.74916826	(fraction of variance due to u_i)				

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F test that all u_i=0:     F(19, 718) =     1.73                 Prob > F = 0.0270
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