FREQUENCY DECISIONS OF AIRLINES ON INTERNATIONAL ROUTES IN UKRAINE

by

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Abstract

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By Ilona Noskova

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I develop a model of airlines that decide upon changing frequencies after a period of operations in a market. I extend simple Cournot-Nash duopoly framework to include two periods, government regulation, and sunk costs of entry. The model is tested with the data on Ukrainian international markets for air transportation.

Entry and exit decisions of airlines depend on exogenous market factors (demand, presence of other carriers) and on firm-specific factors (size, cost structure, country of residence). However, most of the information needed to decide upon a change in frequency is contained in the previous period's frequency.

Ukrainian airlines have lower entry barriers comparing to foreign ones, but also are less productive and often suffer from the lack of capital. Therefore, government protectionist policy is justified for now but should be abandoned when sound markets for capital and leasing services are developed.

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GLOSSARY

"Air freedoms" – rights of foreign carriers to access a country's market.
"Open-sky" agreement - agreement between governments (European and US) on the open access and equal rights of foreign airlines on domestic market.
Agent – a firm (a ticket selling agency, tourist agency, another airline etc.) hired by an airline to sell its tickets. These simple agents get commission of 5-6% of the ticket fare.
Agreement on recognition of carriage documents can be signed between airlines even if there's no corresponding bilateral agreement. The main point is improvement of terms of mutual payments.
Air transportation market is a combination of supply of transport capacities offered by airlines, and demand for transportation, located in a certain place and time.
Appointed carrier – an airline granted an exclusive right, according to a bilateral agreement, to perform international flights to a country with which the agreement was signed. This carrier represents interests of the government on the international air transportation market. Also is referred to as national or flag carrier.
Bermuda-type bilateral agreement – named after a compromise Bermuda agreement between UK and US (1946). Under this type of agreement fares are settled by IATA, and later approved by the sides of agreement; capacity is settled by airlines according to general principles formulated in the agreement, and can be later changed by airlines or state aviation administrations.
Bilateral agreements – main intergovernmental documents allowing states to exchange commercial rights on exploiting interstate air routes. Agreements are the main instrument of international air traffic regulation in Europe. They regulate capacity, tariffs, number of carriers on international routes. Each bilateral agreement includes articles on safety, provision of air navigation, kinds of transportations, geographical points of take-off/landing, change of commercial load, appointment of the carrier etc.
Bilateral service agreements are signed between appointed airlines of the two states between which bilateral agreement was signed. These agreements include commercial rights use, coordination of capacity, timetable, tariffs, mutual payments for airport and air navigation services.
Business fare (C) is 10-15% higher than Y-fare, gives a passenger the right for better in-flight and on-the ground service.
Cabotage – a right of a foreign carrier to perform transportation between domestic cities. Cabotage can be consecutive, autonomous, large and small.
Chicago convention (1944) – the main document regulating general issues of air traffic operation. Includes Warsaw, Paris and other regional (like Havana) conventions. With this convention the International Civil Aviation Organization (ICAO) was created.

Chicago-type bilateral agreement doesn't include statements on capacity and tariffs.

Commercial flight – performed between the points where a carrier has commercial rights (to bring to and from a given city commercial passengers and cargo). Usually these are regular international flights defined by bilateral agreements, charter flights, and those defined by special agreements such as air photography, geology and fishery prospecting, agricultural works, expedition service etc.

Deregulation – the policy adopted by American government in the end of 1970s. It allowed price competition and free entry on the routes.

Economy fare (Y) is the lowest one granting the passenger maximum opportunities of exchange, reimbursement, change of route etc.

Fifth air freedom – the right to take on and off board commercial load in a country for transportation into the third country.

First air freedom – right to fly over a country's territory without landing.

Flag carrier – see appointed carrier.

Foreign representation of an airline represents its interests abroad (sells tickets, controls agents, handles claims etc.). Airlines wishing to develop large scale operation in a region are more likely to open a representation than to sign a general agent agreement.

Fourth air freedom – the right to *accept* (load) commercial load on a country's territory. Third and fourth air freedoms together are usually mutually granted in bilateral agreements.

Free-flight (FFS) – new air navigation system that permits permanent connection of an aircraft with on-the-ground services via satellites. Is used in US and some European countries.

Frequent flyer plan (FFP) – a remuneration program for frequently flying passengers, that foresees a free flight or other service for a certain number of miles flown with an airline.

General agent – the airline, usually a national carrier of foreign country, which represents interests of another airline (domestic flag carrier): handles its passengers, sells its transportation etc. It is obliged to treat hiring airline's flights as its own. The commission of a general agent is usually 10-11% of ticket price. General agent usually has exclusive right to sell airline's tickets on a given territory.

Hard rights define the rights on a route, transportation, and capacity, that can be performed by appointed or other national carrier. These rights are more valuable and stable than soft rights.

Hub – a large airport where a great number of transfers takes place.

Hub-and-spoke system (HS) – a system of organization of transportation when passengers travel with a stopover in a hub: a hubbing airline (or several smaller airlines) brings passengers from smaller (regional) routes to a hub where they take over another (usually international) flight, and vice versa.

IATA – International Air Transport Association – a NGO, whose member airlines define main rules of commercial air transportation and set recommended fares.

ICAO (International Civil Aviation Organization) – specialized UN institution (since 1947) regulating general terms (safety, ecologic standards) of air transportation. Only member state of the UNO can become a member o ICAO. Currently 185 states are members of ICAO.

Interline agreements are signed by airlines that together perform transportation of passengers and/or cargo. They issue one ticket for the whole travel, and passengers often change an airline within the flight. They also share codes, sell each other's tickets and perform other mutual services.

Irregular flights are conducted according to special permissions on one-time flights. There are supplementary, special, and one-time flights.

Load factor (LF)– share (percentage) of seats occupied during a flight.

National carrier – see appointed carrier.

Non-commercial flight – performed without commercial purposes (rescuing, fire-fighting operations, training, testing flights, etc.

Official agents are registered, checked and trained by IATA. An airline can be more confident in such an agent.

One-time (charter) flights are performed according to charter contracts, defining a carrier (freighter) and a client (freightee). Implementation of charter flights are regulated on the basis of appendices to intergovernmental agreements, usually, permissions for a flight is granted if requested no later than 48 hours before the flight.

On-land service agreements are signed between an airline and airport. The standard IATA agreement includes conditions of payments, quantity, price and quality of airport services.

Open-sky – a policy that grants equal rights to foreign and domestic carriers and allows unrestricted access for foreign carriers onto domestic markets.

Paris convention (1919) "On air navigation" defined the right of a state on the air space above its territory. The permission of the state is needed to conduct a flight above its territory. States were obliged to create on-land air navigation systems.

Premium/first class tariff (F) is higher than both Y and C fares (about 50% higher than Y), provides additional service benefits.

Regular flights are conducted according to conditions of intergovernmental agreements on air transportation, and the timetable, settled on the basis of these agreements.

Second air freedom – right to perform a non-commercial (technical) landing on the state territory.

Seventh air freedom – right to perform international regular transportation between the third countries *outside* the territory of a given country.

Sixth air freedom – right to conduct regular international transportation between third countries *through* the territory of a given country.

Slot – certain time period (a few minutes) reserved for take-off or landing of an airplane.

Soft rights – the rights to perform a business granted to the appointed carrier. These rights can be varied within a certain range.

Special flights are performed according to special tasks on regular or special routes. Permissions for such flights are obtained via diplomatic channels.
Special/discount fare is lower than Y fare, but there are some restrictions on ticket exchange and reimbursement, quantity of services is also limited.
State Department of Civil Aviation – the Ukrainian governmental body (equated to a ministry) that regulates air transportation, in particular, grants carriers rights to start operating a route.
Supplementary flights are performed on the same routes as regular ones but according to a separate timetable - usually in case of excess demand for a regular flight.
Third air freedom – right to perform regular international transportation with *unloading* of commercial load on the country territory.
Timetable is the program document of an airline, it regulates the work of all its services. There are summer and winter timetables.
Transfer airport – airport where a passenger transfers, i.e. changes an airline.
Transit airport – airport where a passenger stops over without change of the carrier.
Transportation is the product of transport enterprises. Its core is the delivery of a passenger or cargo from and to a specified point in space, it also can include handling of the subject transported at the endpoints and on the way.
Warsaw convention (1929) first developed the rules of transportation and insurance in civil aviation.

INTRODUCTION

About seventy years ago, when aircrafts just started being used for mail deliveries, hardly anyone could have imagined the scale of airline industry development today.

Yet, in the year 2000 world's airlines carried about 1.6 billion passengers and some 30 million tonnes of freight.[1] This constitutes an increase of 5.4 and 7.5 per cent compared to the year 1999 respectively. Major increase was in the international regular traffic – about 9 per cent in both passengers and cargo carried.[2] International traffic constituted 59% of passenger-kilometres performed and 86% of freight tonne-kilometres performed. In the year 2001 air transportation grew by about 2.5 per cent due to global economic downturn and September events in the USA.

Airline industry is rather concentrated. Of the total air transportation, 70% was accounted for by 30 major airlines. On international routes, 73% of all passengers were carried by the top 30 airlines operating scheduled service. Of these, 11 are European, 10 belong to Asia-Pacific region, 7 to North America, one to Middle East and one to Latin America. National industries reflect the world pattern: there is usually one or two (in U.S. – more) major airlines and a fringe of several smaller ones. The largest volume of scheduled services was performed by United Airlines (23.1 billion tonne-kilometres); in international services the lead took Lufthansa (16 billion tonne-kilometres).

World's scheduled airlines earned operating profits of 3.3% of operating revenues, with Northern American airlines constituting 70% of operating profits.

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[1] These and other general data are taken from Annual Civil Aviation Report 2000, published in the ICAO journal vol. 56, no. 1, January/February, 2001. It can be found at www.icao.org.

[2] Total scheduled airline traffic (tonne-kilometres performed) grew at average annual rate of 5.5% between 1989-2000, with passenger-kilometres growing at 4.9% and freight tonne-kilometres – 6.8% annually.

In the year 2000 Ukraine was ranked 76th in the ICAO's ranking of countries whose airlines performed more than 100 million total tonne-kilometres of scheduled service. Ukrainian airlines performed 1,499 million passenger-kilometres (increase by 10% comparing to 1999) and of these 1,294 million – on international routes (increase by 11%).

It is impossible to imagine modern life without airlines – still the fastest way to get to another end of the world. No doubt aircrafts will remain the preferable means of transport, at least for longer distances, and demand for air travel will hardly fall.[3]

Airline industry, as the one everybody has been in touch with, has become a textbook example of imperfectly competitive yet contestable industry structure, and of the impact of deregulation on an industry where economies of scale are present. Some of the features of monopolistic competition, such as product differentiation (through service), advertising (especially personal one, directed on obtaining and maintaining market share), consumer differentiation (main division – business and economy class), economies of scale and scope are especially prominent in this industry. No wonder that many economists turn their attention to it.

The airline industry drew the attention of economists soon after its deregulation that started in 1977-78 in U.S. and the late 1980s - early 1990s in Europe. European markets have long stayed closed for (more efficient) American carriers. Only in the mid 1990s had some European governments introduced "open sky" policies actively pursued by U.S. Most of the world markets for international air transportation are still regulated through bilateral agreements that sometimes are rather restrictive and define not only endpoints and number of routes but also fares and volumes of transportation. However, airlines can effectively overcome restrictions posed by agreements by formation of alliances.

[3] I doubt that many people choose a ship to America because they are afraid to fly.

After deregulation, the competition between airlines did "exactly what we hoped and expected it to do" (Kahn,[4] 1988), namely, promoted massive entry of lower-cost carriers and severe price competition. Unexpected by supporters of deregulation were development of hub-and-spoke system, numerous mergers and bankruptcies that followed entry, and the large-scale development of alliances and interline agreements, which led to re-concentration of the industry. Airline alliances have become more and more important for the operation of the industry; almost every airline now is a member of an alliance – this membership helps airlines to economize and to overcome some international regulations.

A number of international organisations also regulate the activity of civil aviation, though their recommendations are not mandatory to implement. The main among them is the International Civil Aviation Organisation (ICAO), now accounting for 185 member states, which deals primarily with basic issues such as safety, promotion of growth and development of civil aviation in the world, standardization etc.

The main international body regulating commercial issues in civil aviation is the International Air Transport Association (IATA). It sets "recommended" fares, which are taken as a (maximum) benchmark by airlines when setting their tariffs, provides information assistance to airlines, certifies carriers and ticket agencies etc. Membership in IATA or IATA certificate serve as a "quality sign" for an airline or an agency. Besides, there are regional organizations of carriers such as Association of European Airlines, and also international and regional organizations of airports, pilots, dispatchers etc.

Although there are many papers considering different issues of airline industry, few of them take a look at European markets (probably, also because of unavailability of data), very few consider frequency choice and frequency competition of airlines, and I haven't found any reference applying this analysis to interstate markets.

[4] Alfred E. Kahn, the head of the CAB (1977-1978), "the father of deregulation".

Therefore, using the data for Ukraine, I try to determine and quantitatively estimate factors influencing frequency decisions of airlines on interstate markets. For this purpose I extend the model of Shipper, Nijkamp and Rietveld (1998) to include two periods and government regulation. I show theoretically and confirm with Ukrainian data that previous period's operations of airlines carry much information about its frequency decisions in the next period. Other relevant factors are distance as a proxy for costs, country status of an airline (domestic or foreign), and market variables such as market structure and whether destination city is a major hub (a proxy for route demand).

Ukrainian industry was liberalized relatively soon after independence, and now it is being restructured. The process is rather slow, but I think the time of maximum division has gone, and the next few years will be characterized by mergers. Appearing larger carriers should be more efficient than smaller ones they consist of; hopefully, they will also be able to borrow funds to lease new aircrafts instead of worn-off Soviet heritage. Hence, the growth of airline industry that became positive two years ago should stay in this trend.

Because domestic demand for air transportation in Ukraine is weak, the largest volumes of transportation and largest growth are observed in the market for international transportation. International markets are regulated by intergovernmental bilateral agreements, signed by Ukraine with 50 states. Agreements declare that appointed carriers of the states should share the load equally and "each earn a reasonable profit", i.e. the governments try to protect domestic carriers from competition. However, in case of Ukraine, it is mostly the Ukrainian carriers that need to be protected because only few of them can really compete with, for example, Western European companies.

The thesis is organized as follows. The next chapter is a brief description of Ukrainian airline industry, then I review theoretical issues, develop and estimate the model. Then I conclude and draw policy implications.

DESCRIPTION OF UKRAINIAN AIRLINE INDUSTRY

Since 1991, volumes of passenger air transportation in Ukraine had been falling by about 20% per year until 1999. The main reason was a prolonged economic decline experienced by Ukraine in these years. In 2000 and 2001 airline industry experienced growth of about 7 and 8 per cent respectively. Because of the weakness of internal demand (less than 2% of population use air transport) international passengers constitute more than 80% of all passengers carried. For the same reason number of domestic flights has continuously declined while number of international flights performed by domestic carriers was increasing in the last two years. For example, for the first half of 2001 international passenger stream increased by 17.4%, while domestic decreased by 18%.

More than 30 foreign airlines operate now in Ukraine. They perform about half of international carriages, though in 2000 their share fell to 30%.

In this chapter, I briefly discuss the history of Ukrainian airline industry, industry's infrastructure and some of the airlines, and conclude with a description of the legal route entry procedure.

History

Ukrainian airline industry is (not surprisingly) of the same age as the state. After independence was pronounced, Ukraine had 25 (one in each oblast) regional aviation enterprises, which formerly were parts of the Soviet monopoly – Aeroflot. It is worth mentioning that USSR's Aeroflot was a single enterprise that included all infrastructure (airports and air navigation services) and fleet. It consisted of "united air divisions", one division being an airport with airplanes based there.

In January 1992 the State union of civil aviation "Ukrainian Airlines" was formed. It included everything – an airline, airports, governance, and

regulated all aspects of national air transport. Later the same year it was reorganized into the State administration of Ukrainian air transport.

Ukraine joined the International Civil Aviation Organization (ICAO) in 1992. A year later the Air Code was passed, which is the main document regulating the civil aviation activity in Ukraine. However, it is not very different from the Soviet one, passed in 1967. The activity of civil aviation is also regulated by the Law on Transport and by the Cabinet of Ministers' decrees. The main executive regulatory body is the Department of Air Transport (Ukraviatsiya). Among general issues, such as safety and scientific support of aviation, the state regulates "usage of air space and navigation service". Ukraviatsya certifies carriers and airplanes, gives permissions for starting of operations of a new frequency or route etc. In 1995, Air Traffic Association of Ukraine was created by private enterprises. It represents interests of airlines in case of problems with authorities, e.g. licensing, certification, etc.

During the transformation process airports were separated from the fleet, Air Ukraine airline from the regulatory body. Several regional airlines, as well as Ukraine International Airlines (the main national carrier) were spun off the Air Ukraine during 1996-1999. But reorganization process has been very slow. Some air traffic enterprises still include both airline and airport.

Massive entry and exit occurred in the airline industry since 1992. Small airlines, sometimes leasing just one or two aircrafts, entered mostly the charter market, and often performed as subcontractors for bigger ones. Charter flights market has always been very competitive, though now the number of carriers contracted considerably. Gradually, due to competition and more restrictive certification policy of Ukraviatsiya, introduced because of increased number of accidents, their number decreased somewhat. On the other hand, number of regular carriers had been steadily rising. For example, in 1996 more than 100 airlines were registered in Ukraine, from which only 6 performed regular flights; in 1997 there were about 150 airlines in Ukraine, in

1998 - 92. As of October 2001, Ukraine had 96 certified air carriers, 17 of which performed regular flights.

The ratio between state and private owned companies has been around 50:50, with state companies being mostly unprofitable. By the end of 2002 the government plans to reduce the number of carriers to 20 and liquidate all companies that don't possess an aircraft (now only 30 companies have their own fleet).

Capital and infrastructure

Fleet. The absence of high-quality fleet seems to be one of the main obstacles to the development of Ukrainian airline industry. Ukraine inherited an abundant aircraft fleet, mostly old and consisting of small aircrafts (An-24, Yak-40, Yak-42)[5]. Large aircrafts like Tu-154 or Il-62, even in the good condition, are very fuel-ineffective and don't conform to new ecologic standards.[6] Average depreciation of the fleet reaches 70%, and only a quarter of Ukrainian civil aircrafts are airworthy. For example, as of 2000, Ukraine possessed 615 airplanes, out of which 581 were older than 10 years. Only two Ukrainian airlines have Boeings – UIA owns one and leases five and Aerosvit leases four. Regional airlines plan to use new An-140 (capacity of 52 passengers), which will replace old An-24 and Yak-40. Re-equipment of airlines with these modern planes will take several years because serial production of An-140, which costs about $8 million, has just started, and the first one flew in March 2002. This and other planes will belong to the state leasing company "Ukrtransleasing", created not very long ago. Poor development of capital markets and in particular, absence of domestic leasing companies prevented Ukrainian airlines from effectively adjusting their fleet to the market requirements.

[5]See Appendix 4.

[6] For example, the Air Ukraine flight to New York wasn't profitable even with 100% load and finally was cancelled in 1999 because Il-62 doesn't conform to the new American noise standards.

Due to low profit margins, common for airline industry, airlines can't afford to buy planes. In most of the countries this is not a problem: airlines pay for their fleet through different leasing schemes. But to obtain a plane in such a way (1) a Ukrainian company should have stable stream of revenues to be able to make payments, (2) uncertainty of economic and institutional environment should be low, and because uncertainty is rather high in Ukrainian market (3) state guarantees may be needed. For example, a company that leased B-737 to UIA in 1995, recalled it in 1996 because of unfavourable forecast of Ukrainian economic conditions.

Airports. Ukraine now has 46 civil or dual civil/military airports, out of which 28 have international status.[7] Of these, only 15 were regularly servicing flights in 2001, up from 10 in 2000. Since 1991, passenger flow through airports had been constantly falling, though at a smaller pace than the number of passengers Ukrainian airlines carried (because foreign airlines have performed about half of passenger service in Ukraine), only in 2000 it grew by 6%.

According to the Ministry of Transportation, Ukrainian airports are able to serve about 6 million people annually, but currently operate below 50% of their capacity. The main airport Boryspil has always served more than half of all traffic, and in 2001 its share in passenger transportation constituted 61%. It also serves almost 80% of international flights from Ukraine. Nevertheless, its capacities are also used only for 55%. The second largest Ukrainian airport – Simferopil – serves 3 to 4 times less passengers than Boryspil and its traffic is highly sensitive to seasonality. As of 1999, 15 enterprises still had both airport and airline in it. However, in spring 2002, largest airports – Dnipropetrovsk, Donetsk, Odesa, and Lviv were excluded from enterprises and, together with Simferopil, Zhuliany, and Boryspil, formed a state-owned corporation "Airports of Ukraine". Smaller local airports, namely, Vinnitsa, Mariupil, Kerch, Uzhgorod, Kharkiv, Luhansk,

[7] See also appendix 2.

Kirovograd, Ismail, Ternopil, Kyvy Rig, and Cherkasy, were, after a long process, transferred to the municipal property.[8]

Air Traffic Control. The Ukrainian government has made the modernization of its ATC system a priority.[9] The current outdated ATC system, absence of modern air traffic services, and worn-off navigation and communication systems in Ukraine, have had a negative impact on the country's ability to attract additional flights, carriers, and air routes. Under-utilizing its airspace, Ukraine is losing much on foregone overflight charges, landing fees, gate fees, aircraft service charges, etc.

The Ukrainian State Air Traffic Service Enterprise (UkSATSE) is responsible for the operation of Ukrainian air navigation system (ANS). The equipment and infrastructure used in providing air navigation services needs updating and modernization. At the end of 2000, UkSATSE received a loan of $23 million from the EBRD for the ANS upgrading project and started a tender for installation of voice communication systems in Lviv, Odessa, Simferopol, and Dnipropetrovsk.

For now, UkSATSE has already modernized four ATC dispatcher centers based on Ukrainian internal technology and domestically-integrated western ATC equipment.

All the ATC systems currently in use in Ukraine are designed and manufactured by a local firm, Aerotekhnika. The systems are made as a blend of Western and local equipment/software, enabling Ukraine air traffic controllers to service up to 150 jets simultaneously. All equipment complies with Eurocontrol requirements.

Intermediaries

Agencies and tourist firms have become important participants in the air transportation market. Most ticket sales are now conducted through

[8] An order of Cabinet of Ministers of 26.06.2001 No. 297-p.

[9] "Conception of Development of Civil Aviation of Ukraine" accepted by Cabinet of Ministers' decree of 28.12.1996, No. 1587.

agencies. Agencies achieve economies of scale and increase their product variety by signing agent agreements with multiple airlines. Airlines can economize on sales networks and increase their market by employing several agents from different areas. Therefore buying from an agent is almost always cheaper and more convenient for consumers, who often buy carriage as a part of service package, e.g. a tour. The largest ticket agency in Ukraine is Kyiavia.

Major airlines

Three major airlines perform as much transportation as all other domestic carriers together and about 30% of all carriages, accounting for foreign airlines. Performance of five top Ukrainian airlines can be found on chart 1 in Appendix 5. Although two of the three largest ones will complete merger by summer, I will discuss them separately.

Air Ukraine was created after reorganization of the State Aviation Administration, a successor of the Aeroflot. Its financial soundness and scope of operation has been rapidly decreasing. At the beginning of 1996 Air Ukraine possessed more than 240 planes, in 1999 - 30, out of which only 16 could fly, now it has only 7 airplanes, four of which perform regular flights on 15 routes (at the end of 2000 it served 26 routes). Now it serves about 7% of Ukrainian market for air transportation.

It is still an appointed carrier, and, thought it is greatly indebted (since 1995 it was making on average $4 million annual loss, and now its debt is about $20 million), the government hopes (not for the first time) to rescue it by restructuring. Several times the airline was announced a bankrupt and every time government changed the head of it and provided financial help.[10] There is also an opinion that high turnover of AU presidents was due to the struggle over a contract for three A-320 and two Boeing-767. The contract was nearly signed in 1997 but then the process stopped. Since 1997, regional airlines, such as Donbass-Eastern Airlines and Luhansk Airlines, were

[10] For example, by Cabinet of Minister decree of 25.09.1999 No. 1003-p, bad debts were written off; and the program of "salvation" of the airline was to be drafted. 28.12.2000 again a special group was created "to lead the AU out of the crisis".

separating from Air Ukraine. It was also giving away rights on its Eastern European routes to Aerosvit. After introduction of new European noise regulation this year, AU may further contract its operations in Europe.

Since the last half of 2000, AU has been preparing for privatisation. For this purpose, it was planned to divide it into several enterprises: rescue crew, aircraft technical service, ground service centre, Air Ukraine company that will exploit existing fleet until it completely wears off, an airline performing long-haul flights, and a leasing company. After privatisation 25%+1 share would have remained in the state property. The airline's asset value was estimated to be $8.5 million.

Air Ukraine serves the major part of domestic flights, flights to Eastern Europe and Asia. Although domestic flights are unprofitable, the airline, couldn't cancel them in order not to deprive smaller communities of service.

Restructuring and improvement of financial health of the company are widely talked about but I think sooner or later the assets of the AU (most valuable of them – rights for route performance) will be divided between the other two major carriers (which have recently become one) – UIA and Aerosvit. Perhaps this will happen after the government pays or writes off part of the debts of Air Ukraine, as was often done with other enterprises during the early years of privatisation.

Ukraine International Airlines (UIA) was founded by Air Ukraine (actually, by the state), which gave the newly born company rights to perform flights on 30 most profitable routes to Western Europe. These rights were estimated to be worth 100 million dollars and so the state owned 88% of the company. Another founder was Irish leasing company Ginnes Peat Aviation (GPA) that leased two Boeing-737-400 to UIA (later, it exchanged them for less expensive B-737-200 and during these years leased 3 more B-737-300). In 1996 UIA was separated from Air Ukraine - its state-owned shares were transferred to the State property fund. In 1996 Austrian Airlines (its main partner) and Swissair bought 18% of UIA shares for $9 million. Now the state owns 61.5% of the shares, Austrian Airlines and Swissair – 22.5%, the rest

belongs to Aer FI leasing company (6%) and EBRD (bought 10% of shares for $5.4 million in 2000).

More than 95% of UIA flights are international. UIA has very convenient morning slots in Boryspil and performs some of the flights together with Austrian Airlines – its major partner. In 2001 it served 13 routes, the volumes of its transportation have been steadily increasing by 7-12% annually. In 2001 its carriages have risen by 21.6%, which, among other, can be explained by overall economic growth in Ukraine. Until 2001 it was a leader among Ukrainian airlines by volumes of transportation.

It is a partner in the Qualiflyer Group (with Swissair), Star Alliance (with Austrian Airlines and other), and the Flying Dutchman (with KLM).

Aerosvit was founded in 1994 as a Ukrainian – Israeli joint venture (Air Ukraine was one of its founders). Now 22% of shares belong to Ukrainian government, 40% - to the CJS "Agency of air Communications and Tourism "Aerotour" (with Israeli capital), 38% - to the "Gilward Investments B.V." (Netherlands). At first, it performed a few regular and charter flights, often using the codes of Air Ukraine, but since 1996 it had been using its own codes and has rapidly expanded. For example, in 1999 its carriages grew by 16%, in 2000 – by 50%, and in 2001 it became a leader among Ukrainian airlines by volume of transportation (passenger carriages grew by 34.7% and number of flights by 14%). Currently it serves Eastern European routes (Budapest, Prague, Sofia), Mediterranean region (Tel-Aviv, Athens, Istanbul), and Moscow.

A national carrier. In summer 2002 the process of creation of a large national carrier, which will include UIA and Aerosvit and operate under UIA brand, should be completed. The idea of merger of three main carriers (Air Ukraine, UIA, and Aerosvit) had been discussed since 1999. The main problem was that the other two carriers didn't want to pay AU debts.

The single carrier is expected to be better able to compete with foreign carriers. The merger is most likely to increase efficiency: merged route structure will allow to use aircrafts more effectively (they will spend less time

on the ground) and, reciprocally, larger fleet can allow to increase the number of flights per route and the number of routes. And of course, airlines will stop wasting resources on competition for government support. As airlines were not competing between themselves, except for the Kyiv-Moscow route, prices are not likely to rise because of the merger. However, merger may increase the value of merged airline service – for example, by better coordination of schedules (convenient joining of flights), improved service due to increased competition with foreign airlines and, possibly, lower cost, increased value of FFP (greater variety of "bonus" trips), etc. Because of this, prices can rise but probably not much.

Regional airlines

All regional airlines were created during 1996-1999 in the process of reorganizing Air Ukraine.

The largest regional carrier and third in Ukraine by volume of carriages, is Donbass Eastern Airlines based in Donetsk. Created in 1998, it has been growing by 10% per year. In the first years it served many routes connecting smaller Russian cities (e.g. Tumen, Novosibirsk) with Donetsk, but lately concentrated on flights to Kyiv, Moscow and tourist regions (Turkey, Bulgaria). Other regional carriers are: Dniproavia (Dnipropetrovsk), Tavria (Simferopol), Crimea (Simferopol), Ukraine National Airlines (Kyiv), Odesa Airlines (Odesa), Lviv Airlines (Lviv), ICAR (Kharkiv), Constanta (Zaporizhzhya), Air Urga (Kirovograd) and some other. Although, their total market share is under 30%, they seem to have found their market niches and, better or worse, develop their route structure. They may succeed, as Ukraine Mediterranean Airlines (Kyiv), that, created in 2000, in 2001 became tenth largest carrier. They may fail, as Ukrainian National Airlines, which the government unsuccessfully tried to privatise during 2001.[11] Since 1998 it was announced bankrupt and almost stopped operating.

[11] For the first time an auction was scheduled for May 2001. 76% of shares were selling for $1.3 million. But among the conditions of privatisation were payments of $0.9 million wage arrears, $0.4 million of credit debt and $0.3 million for planes' repair – all this in the first three months after purchase. The

In 2001 government prepared for privatisation several other airlines – Kirovograd Airlines, Odesa Airlines, and Luhansk Airlines. In 2002, Crimea Air and Kirovograd Airlines should be sold, each for about $200 thousand.

Privatisation of unprofitable state airlines goes slowly for several reasons. First - the terms of privatisation are not very attractive, for example, the need to pay company's debts. Second, fleet of most companies is very old, which implies large expenses for repair and/or leasing soon after purchase. Third, the domestic market is weak, and on international markets two problems arise: most profitable routes are already exploited by one of the larger carriers, and some bilateral agreements allow only one carrier per route; and on a new route a need to compete with a foreign, often more efficient, carrier arises.

In the beginning of 2001 several regional airlines (Ukrainian National Airlines, Luhansk Airlines, Odesa Airlines, ICAR (based in Kharkiv), and Lviv Airlines) signed a memorandum on the creation of the Ukrainian Aviation Alliance. The goals of the alliance are: lobbying of interests of air carriers in the government, coordination of flight schedules and tariff policies; creation of clearing centre for carriers and travel agents, and bargaining for lower airport and navigation fees. The largest ticket-selling agency, KyiAvia, also joined the alliance.

Charter carriers

Because of the weakness of internal demand and rather complicated conditions of opening a regular flight, most Ukrainian airlines perform charter flights. In 2001 the share of seasonal charters in the transportation of UAI and Aerosvit constituted about 20%.

Frequently, newly established airlines begin their operation with charter and then open regular flights. There are, however, several specialized charter or rather business aviation airlines. They have in operation 235 small business

State Property Fund three times announced a tender and finally, having not found a buyer, transferred the airline under the management of the plane repair plant #410.

planes, many of which are refurbished Soviet Yak-40 and Czech L-410. lack of funds for refurbishing and/or purchasing of aircrafts is one of the main problems of charter carriers as well.

The market for charter carriages is highly competitive – Ukrainian carriers compete between themselves as well as with foreign companies. Some state regulations, for example, mandatory purchase of in-flight meals from respective airport enterprises, also create difficulties for charter carriers, making it harder for them to compete for passengers by differentiating their service.

Flight opening procedure

According to the government order,[12] a Ukrainian airline wishing to start a flight should present a business plan to Ukraviatsiya, where, among other, it should provide two-year forecast of route performance, proofs of social beneficence of the route and its ability to compete with potential foreign competitor. Then, if it doesn't interfere with corresponding bilateral agreement, the permission for flight is granted. By terms of bilateral agreements, a new flight opened by one carrier implies a possibility for a carrier of the second country to also open a flight, though not necessarily on the same city pair market, which may cause dissatisfaction of domestic carriers operating those other markets.

Lately, Ukraviatsya satisfied all requests for route permissions. In the earlier years it was rather hard for a foreign airline to get permission for a flight because, although Ukrainian companies would automatically receive the right for "reply" flight, they were unable to exercise it because of inappropriate fleet and service level. So, in the years of initial flight distribution mostly the "phone right", i.e. personal relations with officials, was exploited.

Airlines can most easily cancel or introduce a flight only twice a year – when the new schedule is formed. And if an airline cancels a flight in the

[12] Order of Ministry of Transportation No. 41 of 28.01.1999.

middle of the season, this can damage its reputation: when granting permission for new routes, Ukraviatsiya, among other, considers the regularity of an airline's service, and high irregularity can cost an airline a licence to operate. Hence, large entry into southern and Asian routes (like Istanbul, Larnaca, Burgas, Cairo) by smaller carriers can be explained by (1) tough competition on European routes from European companies and UIA, (2) fleet characteristics and (3) relatively high demand for these destinations, especially in tourist seasons (summer).

Ukrainian airlines usually set prices between p* and the maximum tariff set by IATA where p* = cost of flight with load factor of 0.75 divided by number of passengers plus 10-15% profit margin. Actual load factors are often below 0.75 (usually 0.4-0.5 for Ukrainian airlines), so carriers have to keep higher prices to maintain profitability.

THEORY

Airline industry is suitable for study of different oligopoly and monopolistic competition models. Besides, it has its own specific phenomena such as code-sharing agreements or alliances, and recently emerged revenue management, which have become subjects of the latest research. Not the least among the reasons economists turn their attention to the American airline industry is the availability of extensive datasets, collected by CAB, that allow one to assess quantitatively different aspects of the markets and firms' conduct. For example, Barla (1998) using airline market data, found a U-shaped relationship between firm size inequality (the Gini or Herfindahl) and market power.

European airline industry is different from American in that it mostly involves international flights, and, therefore, different aspects of intergovernmental policy are involved. Many European governments provide protection and/or subsidies for major domestic airlines and regulate interstate markets with bilateral agreements. Although the "open sky" policy has been

adopted recently by a number of states, the liberalization is a long process and still far from complete.

Here, I will discuss the main general features of the airline industry.

Airlines' basic product is transportation, and even if this were the only service airlines provided, it would still be differentiated because of different timing of the service. But airlines differentiate their products greatly by offering wide choices of additional services. Demand for each individual flight can never be infinitely elastic – it is always downward sloping. And it depends not only on the ticket price but also on the presence of other flights within a given time range as well as fares and service on those flights. At the times of regulation, airlines competed greatly through services, and after the regulation was abandoned, although fares fell (Borenstein, 1992), service competition, though reduced, stayed in place. Because of impossibility of arbitrage (tickets are personal documents), airlines can easily price discriminate, and consumers can self-select themselves, choosing between different bundles of services attached to a flight.[13] All kinds of discounts (tourist, student, family fares etc.) are used to capture passengers with more elastic demand or those who can spend more time searching for a better price. Thus, price discrimination is used as an instrument of competition.[14]

This is shown by Borenstein and Rose (1994), who quantitatively estimate variation in airline fares. They find expected average difference between two passengers' fares to be 36% of average ticket price. Measuring price dispersion with Gini coefficient, they find increasing price dispersion on more competitive routes. They also distinguish between two types of price discrimination – usual "monopoly-type" (pricing according to consumers' valuation of basic service) and "competitive-type" price discrimination based on consumers' valuation of "brands" (reputation, "class" of an airline and

[13] It is not so clear where to draw the line between product differentiation and price discrimination. For example, one may argue that a flight with fixed date is not the same product as an open-date flight. As costs of these additional services are low comparative to their price, I would say they capture most of consumer surplus. In the thesis I'll distinguish only first-class and tourist class tickets as different products and make further assumption if needed.

[14] Holmes (1989) develops a formal model of price discrimination in duopoly.

additional services it offers). Greater dispersion on more competitive routes indicates prevailing influence of competitive-type price discrimination.

Airlines' cost structure, considered next, makes them reduce price competition and concentrate on gaining market share and "frequent flying" consumers. Price discrimination and product differentiation are some of the methods for this, and FFPs and other marketing devices will be discussed below.

Airlines have comparatively low marginal cost (cost of putting an additional passenger on a plane consist of slightly increased expense on fuel, cost of meal and ground handling of this passenger) and large fixed cost (even an empty plane requires considerable amount of fuel; it needs technical service before an after the flight. Crew salary, costs of using airport facilities (e.g. runways) and air navigation systems are also substantial). Besides, there are certain sunk costs of introducing a new flight: (1) marketing expenses and (2) signalling costs.[15] Due to this cost structure airlines have to charge above marginal cost for their services.

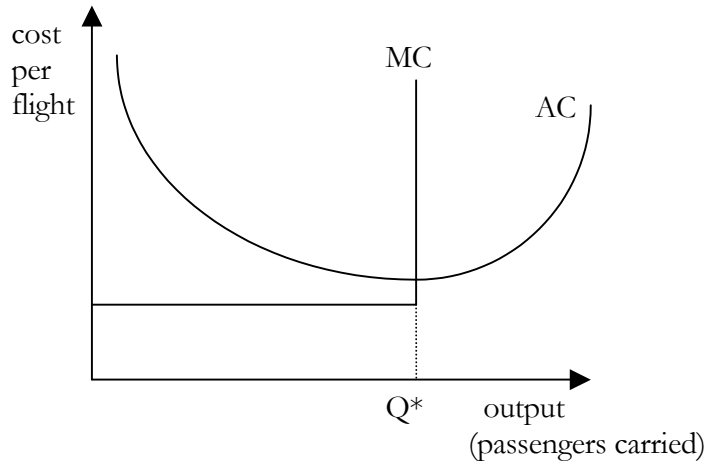

Figure 1. Airlines' cost structure.

[15] Airlines usually charge low promotional (non-profitable) fares for the first several months a new flight is operated in order to signal that they are going to stay in this market for a long time and to attract passengers. During this time airlines try to establish long-term relations with passengers in order to create future demand for their services.

In the figure 1, I sketch tentative airline's cost structure for a flight. Marginal costs are low up to the plane's capacity Q* and infinitely large after that, average costs are decreasing all the way to Q*. As planes are rarely filled up completely, airlines operate on the downward sloping segment of AC.

As noted by several authors, for example, Hurdle et al. (1989), economies of scale exist in airline industry, i.e. average cost is lower for larger aircrafts (under sufficient route demand, of course). Besides, economies of scope (an airline serving more routes has lower AC) arise from the usage of hub-and spoke network. An airline operating a HS can manage costs more effectively, assigning smaller aircrafts to peripheral ("spoke") routes and using larger more efficient aircrafts and increasing load factors on interhub routes. Bittlingmayer (1989), and Brueckner and Zhang (2000) have shown hub-and-spoke network to be efficiency- and welfare-enhancing, though passengers originating at a hub usually pay higher fares than those passing through it.[16]

Airlines' cost structure and relative easiness of entry (because aircrafts are mobile, serving another route by an existing airline shouldn't create much trouble for it) imply industry contestability. However, contestability is imperfect because entry is not costless. As shown by Hurdle et al. (1989), though potential entrants have influence on incumbents' pricing behaviour, three conditions for perfect market contestability are not satisfied: (1) entrants incur sunk cost such as advertising and renting of factors of production (e.g. airport space), (2) incumbents can react with lowering their price before an entrant starts operating, and (3) entrants could have higher cost than incumbents because of economies of scale and scope. Cost of entry may well increase with the number of firms already present in the market because a new entrant has to "fight off" its market niche spending more on advertising and lowering price for the consumers with price-elastic demand.

[16] In Ukraine, hub-and-spoke network has not been developed. Although Kyiv airport Boryspil could serve as a hub, smaller airlines performing domestic flights usually carry their passengers to the local Kyiv airport – Zhuliany, so transfer is not very convenient. Boryspil, however, has been included into European HS system: foreign airlines operating in Ukraine, together with UIA and Aerosvit usually carry passengers to their major hubs (for example, Austrian Airlines – to Frankfurt, LOT to Warsaw etc.) and from there – to all parts of the world.

Another source of an incumbent's advantage can arise from its better access to airport facilities and more convenient slots. Borenstein (1991) shows that a firm dominating an airport has an advantage in attracting consumers both over potential entrants and over the other firm serving the same route but residing at another endpoint. The sources of this advantage are (1) more convenient departure times if the slots were distributed on a first-come – first-serve basis; (2) greater awareness of city residents about "their" airline (this can arise from greater advertising efforts that an airline makes in a city from where it has many flights); (3) consumer "brand" loyalty, induced by frequent flyer programs (FFP's offering greatest variety of trips from a consumer's home city have the highest value for a consumer) or personal experience (consumers are inclined to fly with the same airline if they liked it the first time, and the probability of repeat purchase is greater for the airline that offers greater number of destinations from the home city); (4) CRS ownership and/or plans of agent remuneration. Ownership of a computer reservation system allows an airline to influence agents' decisions (for example, flights of this airline may appear first on the screen) as well as to monitor sales of tickets by agents and implement agent-encouraging programs, for example, increase commissions after certain number of tickets is sold.[17]

Evans and Kessides (1993), controlling for route and firm-specific factors, show that airport dominance gives an airline much more market power than dominance on the route. Berry (1990) considers airport presence to be a form of product differentiation. As incumbents are a major source of airport financing, they gain control over airport facilities, erecting additional barriers to entry and at the same time providing better service - terminals and slots.[18] He finds that airport dominance both lowers airline's costs and

[17] No airline owns a CRS in Ukraine. Both most widely used by agents systems – Galileo and Amadeus – are owned by private operators. State CRS Sirena is used by state airlines.

[18] For example, for the members of its "Club Europe" (business frequent flying passengers) BA provides special ticket sales machines in 43 airports of the world, they are registered for flights separately (i.e. faster), creation of special airport waiting zones for them is planned in 26 airports.

increases valuation of its services by consumers. As shown by Berry, Carnall and Spiller (1996) a hubbing (dominant) airline is able to charge higher prices for business passengers (those with low price elasticity of demand), however, these travellers usually get better service as well. They also find evidence of economies of scope on longer routes.

Because of contestability and severe competition airline industry has low profit margins (about 3% of operating revenues). For airlines, it is almost impossible to reduce production cost through quality reduction because (1) airlines are competing extensively through service, with top world (either most efficient or governmentally helped) carriers setting standards, so that others have to reduce price for any reduction in quality of their service; and (2) airlines can't economize on technical service of their fleet because of safety reasons. To cope with this problem, airlines work in two directions: (1) enlargement of market share and (2) reduction of transaction cost. Desire to create and, more importantly, maintain market share, has led to the development of different devices that induce consumer loyalty. The most common are frequent flyer programs (FFP's), under which consumers get certain remuneration for given number of miles/trips flown with an airline[19]. Direct marketing (like birthday greetings for clients) is also used, though, unfortunately, not in Ukraine (probably, airlines operating here find it not worth it). Some airlines diversify their activities by penetrating into hotel, car rental, tourist business, and finance.

Fairly recent and unique to airline industry phenomenon - formation of alliances - serves both purposes mentioned above: it attracts consumers and reduces transaction costs. It also helps overcome limitations created by government regulation of international markets.

The first major goal of alliances (code-sharing agreements) was schedule coordination. This increased revenues of all participating airlines because passengers are more likely to choose those flights where the time of

[19] Most often consumers are offered a free flight. Airlines also frequently sign agreements with car rental, hotel or tourist companies, and then the remuneration can be a stay in a hotel a guided tour or other service in the city of destination.

stopover and other delays is minimised. Usually airlines entering an alliance or code-sharing agreement sell each other's tickets (this saves the cost of finding agents or opening booking-offices), exchange or lend crews, provide common training for them (saves cost on training and reduces operational expenses), share terminal or other ground capacities (saves renting costs), sometimes lend an aircraft or perform a flight for each other, which saves the reputation of one and brings additional revenue to another carrier. Airlines can also jointly provide FFP's and have quotas of seats on each others' flights. Often participants set a common level of service and fares on their routes.[20] Sometimes alliance partners also hold each other's shares (less than control stock). Major European airlines took active part in privatisation of Eastern European carriers (for example, LOT and UIA), at the same time including them into alliances.[21]

This aspect of airline industry has been extensively considered in the recent economic literature. For example, Chen and Ross (2000) establish theoretical conditions under which alliances with shared facilities (i.e. when entrant is allowed to use incumbent's facility such as terminal) can be anticompetitive in that they deter greater entry by entrant, when he builds his own facility. They argue that, although welfare is raised by the creation of alliance, it could be increased more with greater entry. I think, this is not so clear-cut because duplication of facilities can lead to a waste of resources. The simulation analysis of international alliances by Brueckner (2000) shows that among the two effects, namely, downward pressure on fares on interline markets (where travel on both partner carriers is necessary), and loss of competition on the interhub market (connecting partners' hubs), the first one prevails. So overall welfare is greater than without an alliance.

Based on the assumption of increasing returns to density (greater traffic decreases marginal cost because larger, more efficient aircrafts are used), Nero

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[20] Setting common standard can also divert some airlines from entering an alliance. For example, Emirates Airlines (UAE) refused to enter Star alliance because their standard of service and fares were lower than that of the airline and it was afraid (reasonably) to lose its frequent customers.

[21] Appendix 7 provides the information o the main airline alliances of the world.

(1999) estimates social welfare to be largest when two airlines operating hub-and spoke networks merge, with Cournot non-cooperative equilibrium to be the second best and collusive outcome the worst.

Now I will review several studies directly concerned with the entry and exit of airlines into the markets. Economies of scale and scope, FFPs and other devices inducing consumer loyalty, major airlines' reputation and especially better access to airport facilities all create barriers for potential entrants into a market. A new entrant must bear some sunk cost prior to the entry (market study) and at the time of entry (promotion). It is, nevertheless, relatively easy to enter, and considerable fraction of the authors don't incorporate these costs into the analysis of entry.

One of the earliest studies of influence of free entry onto price and quality of airline services is the paper by Trapani and Olson (1982). Measuring quality of service by load factor, greater LF meaning lower quality, they find (not surprisingly) a clear cost (fare) - quality trade-off and an inverted-U relationship between fare and the number of passengers. Although entry (increased frequency) reduces load factors, price competition stimulates demand, so combined effect of entry is lower fares and quality of service. One of the main results is that very little entry is needed to reach an optimum solution (maximum of passengers carried). This conclusion is consistent with the study of Bresnahan and Reiss (1991), who consider several local markets such as dentists or tire dealers, to find that competitive conduct changes most with second and third entrant, and fourth or fifth have almost no impact on the increase in industry competition. Joskow et al. (1993) study the effects of route entry and exit of airlines on the conduct of incumbents and survivors respectively. Their main conclusions are that (1) high prices don't induce much more entry because (2) incumbents cut prices and maintain output in response to entry and survivors increase both price and output in response to exit. General result, that entry reduces fares and increases output and exit does the reverse, also holds.

Somewhat contrary to their study, Strassman (1990), considering the influence of current prices and concentration on entry decision of potential competitors and on the pricing strategy of existing firms, finds that entry decisions of firms are influenced by current rather than after-entry prices and that current state of competition doesn't depend on market concentration. She also suggests that entry barriers don't influence prices, and calls for a control of mergers because they reduce competition. Her model suggests that in the long run there should be an equilibrium number of firms in the market, though she doesn't concentrate on this issue.

Berry (1992) explicitly incorporates barriers to entry, namely, airport presence, into his model of airline route entry. Considering entry to be an indicator of underlying route profitability, he shows that airport presence has large impact on profitability of hubbing airlines and therefore, an entry by an airline that doesn't have this advantage, will be deterred. He also finds quick profit reduction in the number of entering firms but in his static model doesn't consider competition following entry. He introduces firm heterogeneity and strategic conduct: firms set their prices so as to earn enough profits and at the same time deter entry. One of the policy implications of the model is that reducing barriers for access to the airport may not cause new entry – potential competition will increase, hence lowering current prices and preventing entry. However, he defines entry as an event when a new firm starts operating a market, therefore omitting the possibility of an incumbent to increase frequency to deter entry.

Issues of entry and exit, as well as many others, have been picked up in economic literature mostly after policies of deregulation (in US) and later liberalization (in Europe) were implemented. However, the main effects of deregulation were anticipated by Alfred Kahn.[22] As he predicted, open entry reduced both prices and quality of service, making it accessible for many people who couldn't afford to fly before. Number of airlines also greatly

[22] Alfred E. Kahn. „Applications of Economics to an Imperfect World". *The American Economic Review*, vol. 69, 2, Papers and Proceedings of the Ninety-First Annual Meeting of the American Economic Association (May, 1979), 1-13.

increased and in general number of routes rose, though some smaller communities were excluded from service. However, Kahn and others didn't anticipate[23] the emergence of hub-and-spoke network as well as a powerful wave of mergers and bankruptcies that followed initial increase in the number of carriers. Similar processes occurred in Europe, where out of 131 airlines that had entered the market since liberalization in 1993, half had stopped operation by 2000. Much debate has been going on between USA and Europe around the protectionist policies of European governments towards their domestic carriers (Nayar, 1995). As a result, now 34 European countries operate "open sky" policies, which imply unrestricted access of foreign airlines to European routes, as well as 5th and 6th air freedoms.

Marin (1995) looks at European deregulated markets. He finds increased overall welfare on liberalized routes, stronger competition, lower prices and greater product differentiation. However, flag carriers and incumbent airlines still have an advantage over new entrants because of their better access to airport facilities and price reservation systems, and this influences market structure. In his model, with price regulation, firms maximise joint route profit (like collusive oligopoly), whereas on liberalized routes they behave as in non-cooperative Cournot oligopoly.

This conclusion is supported by Gonenc and Nicoletti (2000), who perform a large survey of European airline industry. By estimating different country- and route-level regressions for the OECD countries, they find that (1) few of international markets are truly competitive – most of them are dominated by flag carriers or an alliance; (2) alliances tend to raise fares as their route market share increases; (3) airport dominance with one firm controlling about half of the slots is quite common, and it, as well as airport congestion, raises business tariffs while presence of charter flights reduces fares, but only discount ones. At the same time they find the evidence of "potential entry" hypothesis, i.e. markets are contestable enough for fares not to depend on market structure. Although competition lowers fares, they are

[23] Alfred E. Kahn, "Surprises from airline deregulation", a discussion, May, 1988.

primarily influenced by regulation and national market environment (see also appendix 1 on bilateral agreements).

The issue of product differentiation after deregulation is extensively considered by Good, Nadiri and Sikles (1991). They develop a model of firm behaviour similar to that of American airlines just after the deregulation. Using the variable cost function rather than time to represent changes in technology, they show that firms had to undertake great structural cost adjustments and differentiate their products more. For instance, after subsidies were cancelled, it became unprofitable to operate wide-bodied aircraft on short-haul routes. Also, part of the labour force was fired but the salaries of remaining staff were increased. This means that productivity in general and productivity of labour in particular increased, and generally, deregulation increased efficiency.

The first years after deregulation in Europe and USA and after the airline industry creation in Ukraine were marked by a great number of airline mergers and bankruptcies. It's a natural process for this industry because (1) due to large fixed cost airlines can't sustain severe price competition for a long time and (2) due to economies of scale larger firms have cost advantage, so number of firms in the industry has to eventually decline. But sometimes governments intervene either to rescue an airline from a bankruptcy if it is believed to provide a socially valuable service[24] or to prevent a merger, if it is considered to increase monopolization of a market.

Indeed, Kim and Singal (1993) find that (not surprisingly) mergers increase market power and hence increase product prices. They also make shareholders better off by increasing share value of a firm due to economies of scale, better managerial performance, and perhaps improved expectations about the firm's future profits. A merger can also benefit consumers by improving quality of service. The authors, however, find prevalence of market

[24] Especially this is true for European governments when the question is about flag carriers. Also,Air Ukraine and Ukrainian National Airlines, though in a bad financial condition, didn't close unprofitable flights to smaller Ukrainian cities and didn't reduce the number of (also non-profitable) flights to Eastern Europe: the existence of service there is a kind of public good, therefore, the state is believed to be obliged to provide it.

power over efficiency gains in airlines' pricing strategy. Therefore, they conclude by calling for increased antitrust measures of governments.

Borenstein (1990) performs a case study of two mergers where a merger was combined with increased airport dominance. One of the interesting observations he does is time dispersion between merger and the expressions of market power, i.e. price increase occurs before the merger while market share changes only after it. Fares increased on routes served by both merged partners as well as on those served by only one of them.

Borenstein and Rose (1995a) consider bankruptcy as a factor influencing airlines' strategic behaviour. They find that bankruptcy and bankruptcy protection do reduce airline prices somewhat but this doesn't affect their competitors because the market share of a bankrupt airline also decreases due to the reduction in funds available for operation, management crisis and loss of reputation.

Among concerns that arose after deregulation was safety reduction – there was an opinion that price competition would force airlines to economize on safety procedures. Indeed the number of jet crushes somewhat increased after deregulation. But Golbe (1986) finds no significant relation between safety and profits and thus concludes that profit- reducing changes in regulation will not influence safety. In fact, economizing on safety can lead to profit reduction due to fall in demand for an airline's services after an accident. Borenstein and Zimmerman (1988) show that demand became weakly responsive to crashes after deregulation, and loss in equity value due to a crash constitutes about 1%. The main conclusion is that social cost of an accident are much higher than the cost airline bears (usually planes and passengers are insured), creating the incentive for strict government control for airline safety measures and quality of aircraft manufactured.

Recent papers on airline industry consider specific features of it that appeared lately. For example, Netessine, Dobson and Shumsky (2000) construct an algorithm of optimal revenue management; Armantier and Richard (2000) find that exchanges of cost information, that may arise when

airlines form an alliance, increase both airline profits and consumer benefits due to decreased uncertainty of airlines about their counterparts' behaviour.

The model

The model analyses frequency equilibria in duopoly airline markets in the Cournot-Nash two-stage setup. In the first stage, airlines decide upon frequencies, in the second stage they set prices treating each other's prices and frequencies as given. The game is solved by backward induction, first determining price and then frequency equilibrium.

The assumptions of the model are as follows.

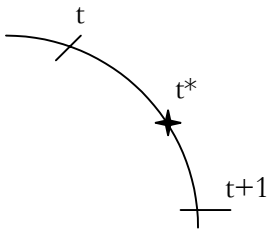


Figure 2. Preferred and actual departure times

Consumers are distributed uniformly with density D on the circle of unit length (a week). They receive some utility *U* from flight and disutility from price they have to pay and delay, which is measured by deviation of actual departure time from consumer's best preferred. In figure 2, *t** represents consumer's preferred departure time, *t* and *t+1* – departures of consequent flights. The distance between *t* and *t** is equal to *x*, between *t+1* and *t* - (1/n – x)*, where *n* is the total number of flights; $n=n_1+n_2$. Flights are distributed evenly across the circle because of (1) uniform consumer density and (2) assumption of (exogenous) maximal interlacing. The last assumption is very reasonable in the context of international practice for the following reasons.

Because consumers' density in practice is not homogeneous over a week, governments follow that their airlines operated in approximately equal conditions. For example, it would be unfair if one airline had all flights during the weekend and another – during the week. Besides, if an airline operating subsequent flights charged a monopoly price there, it would be worth for another one to start operating a flight in between at slightly lower price thus cutting off market share from the first one. This would lead to a price competition, ruinous for both airlines. Finally, if we imagine airlines opening

flights one at a time and one after another, we automatically get maximum interlacing from the assumption of non-price competition through spatial product differentiation. In appendix 6, the arrangement of flights on several international routes is shown. We see that it fits maximum interlacing assumption rather well, and discrepancies can be attributed to non-homogeneity of demand along the week.

Another crucial assumption that makes the model analytically tractable is that the price doesn't affect the decision of a passenger to fly, i.e. passengers don't choose other means of transport if flying is expensive. This assumption is rather unrealistic but it holds for business-class passengers with inelastic demand. Formally it means that $s(p + ax) = 1$, where s is a share of all potential passengers who choose to fly at current price (p) and delay (x).

The model proceeds as follows. A consumer standing at t^*, is indifferent between flights at t and $t+1$ if he gets equal net utility from them, i.e.

$$U - p_1 - ax = U - p_2 - a(1/n - x),$$

Where p_1 and p_2 are the prices of the flights and a is marginal disutility from delay. From here

$$2x = (p_1 - p_2)/a + 1/n,$$

and total demand for a flight is

$$q = D*2x = D((p_2 - p_1)/a + 1/n).$$

There are two airlines on a route. Total demand for an airline's service depends on the number of flights it and the rival serve. If their frequencies are equal, i.e. each flight is surrounded by two rival flights, total demand of each airline is just n_i*q, where n_i is frequency of i-th airline, $i=1,2$. If one airline has

more flights than another, it will have at least two flights with one non-rival neighbour. Between these flights x will be equal to $1/2n$ (because price is the same), i.e. flights will share the consumers equally. Because there is an even number of such market segments, total demand for this airline's (let it be airline 1) services will equal

$$Q_1 = n_2 D((p_2 - p_1)/a + 1/n) + (n_1 - n_2)D/n\,.$$

Consequently, airline 2 will face demand

$$Q_2 = n_2 D((p_1 - p_2)/a + 1/n).$$

Airlines have equal constant marginal cost c per passenger and fixed cost F per flight.

Profit maximisation yields, assuming $n_1 \geq n_2$, equilibrium prices:

$$p_1^* = c + a(2n_1 + n_2)/3n_2(n_1 + n_2);$$
$$p_2^* = c + a(n_1 + 2n_2)/3n_2(n_1 + n_2).$$

Frequencies can be found from

$$2Da(2f_1^* + f_{min})/9(f_1^* + f_{min})^3 = F,$$

where f_{min} is a minimum possible frequency. This result follows from the fact that profit of airline 2 is strictly decreasing in its own frequency, i.e. airlines' game in frequencies looks similar to Battle of the Sexes and is depicted in figure 3 with hypothetical payoffs.

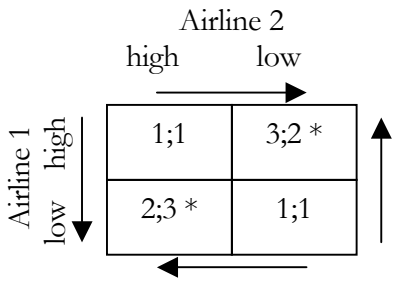


Figure 3. Airlines' game in frequencies

Now I will develop several extensions of the model.

First, let's introduce a regulation, according to which higher prices should reflect higher quality of airline service. Therefore, if we assume that consumers get different utility from airlines' services but that

$$U_1 - p_1 = U_2 - p_2,$$

we get $q = D/n$ for every flight, and $Q_i = Dn_i/n$.
An airline's profit is

$$\pi_i = (p_i - c_i)Dn_i/n - n_iF, \quad (1)$$

Maximizing airlines' profits with respect to frequencies, we get

$$n_1 = n_2 (p_1 - c_1)/(p_2 - c_2), \quad (2)$$

where c_1 and c_2 are their marginal costs. If marginal costs are equal, whichever airline has higher price, and therefore, higher quality, should have higher frequency. Assuming for simplicity that $c_1 = c_2 = c$ and substituting the reaction function (2) into expressions for profit maximization (1), we get the following expression for equilibrium frequencies:

$$n^*_i = (D/F)(p_i - c)[(p_j - c)/(p_i + p_j - 2c)]^2, \quad i=1, 2; j=2, 1. \quad (3)$$

Optimal frequencies are increasing in both own and rival's prices and this is precisely what was observed when U.S. airline industry was regulated: being unable to compete through lower prices, airlines competed through higher frequencies and better in-flight service.

If the government sets $n_1 = n_2$, a higher quality airline, though is not maximizing its profits, still has higher profits than lower quality – lower price airline. But profits of a lower-quality airline will rise. See appendix 8 for derivation of expression (3) and detailed examination of reaction functions and the Nash equilibrium.

Now we turn to the airline's problem of changing the number of flights. Suppose an airline entered the market in the previous period (period 1) and operated with frequency n_i. Now airline either reveals that the true demand is different from what it expected when entering the market, or it faces changes in demand for its service either because more consumers become aware of it and (dis)like it or because of an exogenous shock. Airline chooses frequency for the present period (period 2) to be m_i. Let $k_i = m_i - n_i$ denote the change in frequency between the two periods. We now also introduce sunk costs of opening a new flight into the model.

In the first period an airline maximizes

$$\pi_i = T((p_i - c)Q(n_i, n_j, p_i, p_j) - n_iF) - n_iS, \qquad (4)$$

where T is the number of weeks per period ("summer" or "winter" half-year period usually has 26 weeks), and S is the (fixed and equal for both airlines) sunk cost of opening a flight.

In the second period an airline maximizes

$$\pi'_i = T((p'_i - c)Q(m_i, m_j, p'_i, p'_j) - m_iF) - k_iS_i(n_i, n_j). \quad i=1,2;\ j=2,1. \quad (5)$$

where π'_i, p'_i, p'_j denote respectively profit and prices of the current period. S_i is again sunk cost of opening a flight but in the second period it is a function of the previous period's frequencies: $S_i = S_i(n_i, n_j)$ if $k_i > 0$ and zero otherwise. S_i negatively depends on previous frequency of the i-th airline and positively on the previous frequency of its rival,[25] i.e. $\partial S/\partial n_i > 0$, $\partial S/\partial n_j < 0$.

In each period the game is solved by backward induction – first for prices and then for frequencies. Expressions for p_1^* and p_2^* don't change,

[25] With greater prior frequency airline may get some discounts for the use of airport facilities, it may already know the market and have established contacts with clients, which reduces marketing expenses. Rival gets the same advantages from former-period flights, which thus turn at disadvantage of the first airline.

and to find equilibrium in frequencies, we solve the first order condition of the profit expression (5):

$$\partial\pi_i'/\partial k_i = \partial\pi_i'/\partial m_i = T[(p_i' - c)\,\partial Q_i/\partial m_i - F] - S_i = 0.$$

Using our simplifying assumption on demand, $Q_i = Dm_i/m$, we get the following expression for second-period frequencies:

$$m_i^* = [DT(p_j' - c)(p_i' - c)^2(S_j + TF)]/[(p_i' - c)(S_j + TF) + (p_j' - c)(S_i + TF)]^2.$$

And for the first period the frequencies are

$$n_i^* = [DT(p_j - c)(p_i - c)^2]/[(S+TF)(p_i + p_j - 2c)^2].$$

Therefore, we can express $k_i = m_i^* - n_i^*$ as a function of prices of the second an first periods and S_i, S_j. But when deciding upon frequencies, we hold current prices fixed (they are found in the first step of the solution) and past prices cannot be changed this period. Therefore, we can write

$$k_i = k_i(S_i(n_i, n_j), S_j(n_i, n_j)) = k_i(n_i, n_j). \qquad (6)$$

This expression shows that change in frequency between the two periods can be expressed as a function of past frequencies. Intuitively, frequencies of the previous period absorb all available at that time information on demand and cost, they also can influence demand (e.g. generate repeat passengers) and cost of introduction of a new flight. All this information is taken into account when decision on change in frequency is made.

Using (6), we can rewrite profit expression (5) as

$$\pi'_i = T((p_i' - c)Q(m_i(n_i, n_j), m_j(n_i, n_j), p_i', p_j') - m_i(n_i, n_j)F) - k_i(n_i, n_j)S_i(n_i, n_j),$$

making this period's profit a function of the last period's frequencies. We use this for the definition of dependent variable in the next section.

ESTIMATION

I use the data on 65 markets (86 observations) for two periods – summer 2000 and summer 2001.[26] Of these observations, on 17 markets entry (increase in frequency) occurred and on 12 markets – exit.

Most frequent destinations are Moscow, Frankfurt, and Tel-Aviv. (charts 2 and 3 in appendix 5). Frankfurt is attractive as a stop-over place where passengers transfer to other Western European and Transatlantic routes operated by Lufthansa. Moscow and Tel-Aviv are popular because of tight business and personal relationships of Ukrainians with Russian and Israelian people. Moscow is the only large route where actual competition occurs – several airlines perform flights there.

I base the econometric model on Berry (1992) and Joskow et al. (1994).

The left-hand side variable is defined as follows. If the number of flights on a market by an airline increased, the variable equals 2, if remained the same – 1, if decreased – 0. I assume that these discrete responses reflect a latent variable y^* that represents this period's profit *if* the frequency didn't change. When this profit is greater than cost of introducing another k_i flights, entry (increase in frequency) occurs, when it is less than cost of opening another flight, airline doesn't change its frequency, if it is negative, the number of flights is reduced, i.e. exit occurs.[27]

Formally, dependent variable is defined as

$$y=2 \text{ if } y^* \geq k_i S,$$
$$y=1 \text{ if } 0 \leq y^* < S,$$

[26] Using the same periods allows to avoid seasonality problem. Airlines' demand has large seasonal fluctuation, and winter schedule of airlines differs much from summer schedule because of this.

[27] There is no cost to exit, except, probably, for reputation loss.

$y=0$ *if* $y^*<0$.

On the right-hand side I include:

Market –specific factors

Distance. This variable stands for airline's (fixed) costs of operating a route. Following Joskow et al (1994), I include log of distance and log of distance squared because the relationship between distance and cost is nonlinear. Log of distance should have positive sign – as distance increases, an airline experiences less competition from other means of transport and therefore, probability of introducing a flights should increase. However, when distance is large, cost becomes large, and therefore, the sign of the squared term should be negative.

Average income in the region: data by oblast taken from Derzhkomstat. Although absolute value of income is rather low, its variation by region indicates the difference in business activity, so in regions with higher income probability of increased air service should be higher.

Population of the cities. Variable equals geometric mean of the two endpoints' population. I also use the log of this variable. Larger cities will have greater potential demand for air services, so the coefficient on this variable should be positive.

Dummy variable for major hub. This variable equals to one if many connections are made from a destination city to other places. People flying from Ukraine mostly stop over in Paris, London, Frankfurt, Warsaw, Vienna, and Prague for America or Western Europe and in Moscow also for cities in the Russian Federation and Central Asia. The more connections can be made from a certain airport, the more passengers will travel there, so this variable should have positive effect.

Monopoly. A dummy variable equal to 1 if a market is served by only one airline. It is not a monopoly in a textbook sense because entry is not blocked, though for some reason hasn't occurred (for example, another airline didn't have enough resources, e.g. fleet to start operations). But for simplicity I will

call a market with one airline a monopoly. A priori the impact of monopoly position is hard to predict. If former period frequency was low, a monopoly will have incentive to increase it. At the same time other country's government will have an incentive to oppose increase in frequency on a route served by one airline hoping that domestic airline will start operations there.

Airline-specific variables

Load factor. This variable is taken from ICAO statistics and represents average load factor of an airline. This figure should reflect airline profitability and thus should positively influence an airline's entry decision. Unfortunately, I don't have the data on route load factors, but the sign of these could not be inferred a priori because (1) low load factor means low profitability of an airline and/or weak demand and, therefore, negative influence on entry, and (2) if load factor is high, introduction of new flights can reduce it and thus lower profit. Hence, low route load factors would probably have negative impact on the probability of entry and high LF can have either impact. Average load factors of airlines will probably be insignificant.

Former Operations - number of flights per week in the previous period (2000) performed by an airline on the route. The sign of this variable depends on two effects: on the one hand, airline's presence on a route may reduce uncertainty about future demand as well as cost of introducing another flight (for example, market study and promotion); on another hand, if the number of flights is already large, introduction of another one may reduce load factor and per flight profit; and it may also induce resistance of other country's authorities wishing to protect their national carrier. Combined effect is most likely to be negative.

Domestic - a dummy variable equal to one if airline is domestic and zero otherwise. Domestic airlines, other things being equal, should have lower probability of opening a route because of capital constraints (they have very little planes of adequate quality).

I also add interaction terms, namely, the product of *Former Operations* with *Domestic* and *Monopoly* dummies.

Summary statistics of the independent variables are presented in the table 1.

Table 1. Summary statistics of the RHS variables.

Variable	Mean	Standard deviation	Minimum	Maximum
Log of distance*	0.3294599	0.51851	-0.8989421	2.024061
Log of distance squared	0.3742703	0.72718	0.0001668	4.096823
Load Factor	0.5490698	0.11003	0.34	0.84
Income, UAH	4372.647	2192.03	1256.6	6121
Former operations	3.05814	2.3929	1	12
Domestic*former operations	1.767442	2.20521	0	12
Monopoly*former operations	1.081395	1.67483	0	9
Monopoly	0.4883721	0.502797	0	1
Domestic	0.6162791	0.4891434	0	1
Major hub	0.3837209	0.4891434	0	1

* Distance is in thousand kilometers.

Estimation results

I tried different regression specifications that included distance variables and all possible combinations of other variables. The results were as follows.

Distance variable was positive but insignificant. This probably indicates that distance influences airline's decision only when it starts operations on a route. In the next period this information on cost, represented by distance, is already incorporated in the former frequency. Log of distance squared is negative, as predicted, and significant, meaning that on longer routes, where costs are high, probability of opening a new flight is lower ceteris paribus.

Coefficient on income variable was everywhere insignificant, of small magnitude and changed signs. Therefore, average income in an oblast is possibly not a good measure of potential demand because, as noted above, Ukrainian people don't use air traffic much. Besides, official data do not reflect correctly people's income because large part of it is generated in the unofficial economy. Insignificance of this coefficient may also be caused by small variation of this variable in the data. Not many Ukrainian regions have international air service; therefore, income variable takes on only 10 values.

Coefficient on population, surprisingly, also was insignificant and changed signs in different specifications. This, however, may reflect the fact that there is a large share of transit passengers on the planes: for example, from the passengers flying from Kyiv to Paris, half may actually fly to New York. The data don't allow to estimate the share of transit passengers, unfortunately.

Coefficient on dummy variable for major hub is positive, as expected, and significant.

Coefficient of the load factor was negative but insignificant. Average load factors, as was expected, turned out not to be good proxies for route load factors of airlines.

Domestic dummy has negative sign, as expected, confirming that domestic airlines are resource-constrained and therefore, other things equal, have lower probability of increase in frequency.

Coefficient on the 'former operations' variable turned out to be significant in all specifications and negative. High significance indicates that airlines base their decisions mostly on the results of the previous operation in the market, i.e. they adjust their beliefs in a Bayesian way. Interestingly, interaction of former operations with domestic dummy yielded positive sign, which can be explained by (1) small number of flights initially operated by domestic airlines on a market (i.e. there was unsatisfied demand or unexploited right for flights on the market) and (2) by government support (or absence of barriers) for domestic airlines' operation increase (this

explanation, however, has little power for the last years). The first explanation is the most likely, especially considering the fact that the sample included regional markets, for example, originating from Odesa, Simferopol, Lviv, where demand is growing, whereas most foreign airlines prefer flying to Kyiv, where market is rather tough.

Positive coefficient on interaction term of former operations with domestic dummy is in line with the recent tendency towards the increase of the share of domestic carriers in total transportation – from about 30% five years ago to about 50% since 2000. This is confirmed by the positive coefficient of the interaction term of former operations with monopoly dummy. Although there are some markets with only a foreign airline operating (e.g. Kyiv-Riga, Kyiv-Minsk), markets where only a domestic airline operate, prevail in the sample. Besides, frequencies on the markets with just one airline are small, causing positive influence on the probability of entry.

Coefficient on monopoly dummy alone was negative. The most possible reason for this is government counteraction to frequency increase because intergovernmental agreements foresee equal conditions for both countries' carriers. If a route is operated by only one airline, another country's government may be afraid that when its airline wants to exercise its right to enter that route, there will be not enough demand or slots left for it. Therefore, the government will oppose increase in frequency on a monopolized route. Another possibility is the weakness of demand for these routes – probably one airline operating a couple of flights is just enough to serve the market.

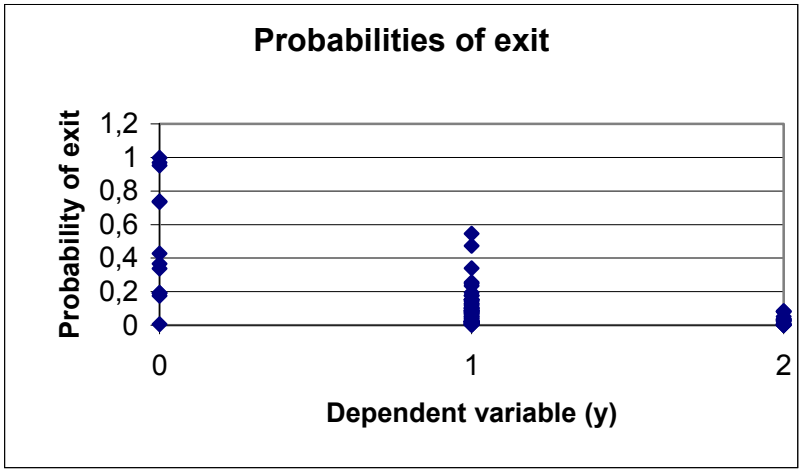
In the following table I present the result of the two ordered probit regressions. The first one is included just for illustration – in other specifications results were similar concerning magnitude and significance of coefficients.

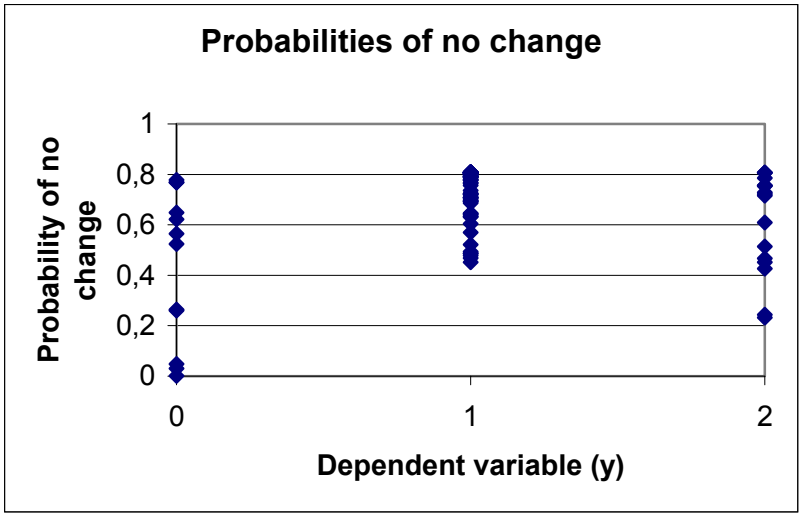
Table 2. Regression results. Dependent variable = 0 if frequency decreased (exit), = 1 if remained the same (no change) and =2 if frequency increased (entry). Estimation method – ordered probit.

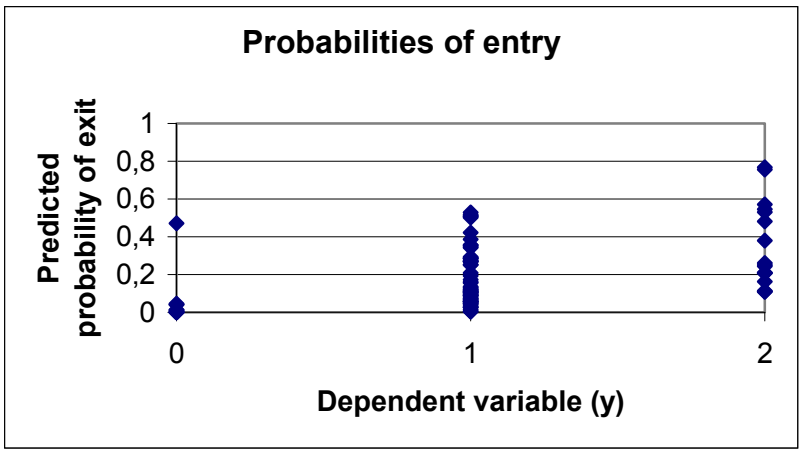
Variable (P>|z|)	Regression 1	Regression 2
Log of distance	0.4302443 (0.311)	0.3378512 (0.405)
Log of distance squared	-0.9310155** (0.027)	-0.8866418** (0.028)
Former operations	-0.4417302*** (0.000)	-0.4372738*** (0.000)
Domestic dummy	-1.769354*** (0.005)	-1.530749*** (0.002)
Monopoly dummy	-0.802494 (0.124)	-0.8342435* (0.096)
Monopoly*Former operations	0.4423214*** (0.004)	0.4504351*** (0.003)
Domestic*Former operations	0.3198159** (0.018)	0.2955183** (0.021)
Major hub dummy	0.7091736** (0.037)	0.6094666** (0.044)
Load factor	-.8974099 (0.618)	-
Income	0.0000245 (0.757)	-
Log of population	-.2066203 (0.527)	-
Dummy for tourist destination	0.112586 (0.795)	-
Pseudo $-R^2$	0.2686	0.2642

Note: * -significant at 10% level, **- at 5%, ***- at 1%.

Below I present the three chart plotting predicted probabilities of entry, exit, and no change in frequency against the actual values of the dependent variable.







These charts show how well the model predicts actual outcomes. Theoretically, on the exit chart high probabilities should cluster at y=0 and low at y=2, at entry chart the opposite holds. For no change, high

probabilities should cluster at y=1. Actual distribution of probabilities resembles theoretical pattern, though not very closely. This can be explained by (1) government intervention that restricts entry of foreign airlines or supports domestic ones and (2) the pattern of the data, where most outcomes have the value 1. Nevertheless, the model predicts actual outcomes fairly well, which can be seen from the following table (an outcome was considered to be predicted if its probability was the highest between the three; it was also higher than 0.5).

Table 3. Actual versus predicted values for y.

		Actual outcomes		
Predicted outcomes		**0**	**1**	**2**
	0	5	0	0
	1	7	51	12
	2	0	6	5

Totally, the model correctly predicts 71% of outcomes. The highest value of probability of exit – 0.998 was found on the route Kyiv-Toronto, where frequency reduced from 2 to 1 per week. The highest value of probability of no change – 0.808 was on the route Kyiv-Tbilisi; the highest probability of entry – 0.767 – was observed on the route Kyiv-Moscow, where Russian airline Aeroflot increased its frequency from 7 to 12 flights per week.

The following table represents marginal effects – derivatives of the probabilities of entry, exit, and no change estimated at the means of variables. For dummy variables the cells of the table represent the influence (percentage change) on the probability of an outcome of a change of the dummy from 0 to 1 when other variables are estimated at their means.

Table 4. Marginal effects on the probabilities of outcomes.

Influence on probability / Variable	Of Exit	Of No change	Of Entry
Log of distance	-4.797	-1.961	6.75
Log of distance squared	12.59	5.147	-17.736
Former operations	6.209	2.5383	-8.747
Domestic dummy	21.735	8.886	-30.621
Monopoly dummy	11.846	4.8427	-16.688
Major hub dummy	-8.654	-3.538	12.192
Domestic*former operations	-4.196	-1.715	5.912
Monopoly*former operations	-6.396	-2.615	9.012

We see that the largest negative influence (-30.6%) on the probability of entry has domestic dummy. This means that domestic airlines experience difficulties when entering routes, mostly connected with drawbacks of aircrafts (fuel-ineffective, require large maintenance costs) and probably with lower effectiveness of management comparing to the foreign enterprises. Squared distance term has also large negative impact on the entry probability meaning that large costs of operating long routes tend to reduce frequency on these markets. Monopoly dummy has a 16% negative influence on the probability of entry implying that governments oppose large frequencies on routes with just one airline operating, adhering to the terms of bilateral agreements that declare equal positions for the two countries' carriers. Other marginal effects are interpreted similarly.

Large marginal effects of dummy variables comparative to the 'former operations' variable can be explained by the fact that dummies take on only two values, whereas 'former operations' vary from 1 to 12. Each additional flight in the previous period reduces the probability of introducing other flights next period by 8%.

CONCLUSION

In the thesis, I analyze decisions of airlines about change in frequencies in interstate markets and test the model with the data on Ukrainian international routes. I augment the model of Cournot-Nash duopoly, extending it for two periods and incorporating the government and sunk costs of entry into it. The econometric model is estimated with ordered probit and it predicts fairly well – 71% of outcomes are predicted correctly.

The model suggests that previous operations of an airline contain much information about the probability of its subsequent behaviour. Previous frequency influences both sunk costs of introducing an additional flight and government decision about granting the permission to perform it. Results indicate that there is a potential for further developing of Ukrainian routes, i.e. there is unsatisfied demand. This follows from the fact that, although former operations and domestic dummy variables have negative influence on increase in frequency, their interaction has positive impact. Therefore, the government is probably "reserving" the frequencies for Ukrainian airlines until the time they are able to operate them.

As economy will continue to grow, according to some forecasts, domestic, as well as foreign demand for air travel will continue to rise and new entry should occur. However, if the government allows free entry, there is a clear possibility that Ukrainian international routes will mostly be served by foreign airlines, which have more resources for this and also are more cost-effective. Although bilateral agreements state fairness as one of the main principles, Ukrainian carriers would not be able to exercise the right for additional flights, which is granted to them whenever a foreign airline increases its frequency, because of their tight capital (fleet) constraints. The largest Ukrainian carriers - UIA and Aerosvit – can compete with such airlines as KLM or Austrian Airlines in the quality of service, but together they operate only 10 Boeings (the only Boeings in Ukraine), which is not enough to maintain desired frequency on all potentially profitable routes.

Therefore, I think, government protectionist policy is necessary for Ukrainian carriers in the current period, especially taking into account the fact that with help of alliances and interline agreements many restrictions created by bilateral agreements can be overcome.

But the priority should be given to policies that will ensure future long - run development of the airline industry. In the first place this is the development of capital markets where airlines could borrow funds necessary for capital investment. Overall economic stability would reduce risk of lenders and make terms of borrowing more favourable for long-term borrowers.

The development of capital markets and economic soundness should help domestic airlines in contracting with foreign leasing companies; however, the development of domestic leasing companies is a necessity. The first Ukrainian transport leasing company "Ukrtransleasing" was created only the last year (but better late than never). Hopefully, the project with new Ukrainian aircrafts will not stop at the beginning either, allowing for development of regional short-haul flights and business aviation, demand for which should grow as the economy expands.

In the long run, the Ukrainian government should abandon much of its regulation letting domestic airlines compete with foreign carriers and between themselves on their own, thus providing them with incentives to use more effective facilities and management methods. And if Ukraine wants to enter the European community, it will need to carry out, among other liberalization policies, also more liberal policy (up to 'open sky') of airline markets regulation.

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Appendix 1. **Bilateral Agreements.**

Almost all foreign carriers operating in Ukraine actually exercise the right of sixths air freedom, i.e. they carry Ukrainian passengers to their hubs and then to third countries. This is possible to do through alliances with domestic carriers.

An agreement usually consist of such articles:

1) **Clause enacting**.
2) **Definitions**
3) **Granting of rights**. Specification of air freedoms. No cabotage rights are granted.
4) **Appointment of carriers**. Number of carriers can be specified. Countries have to grant them permissions for flights right after appointment.
5) **Abatement and cease**. Circumstances under which flight permission can be cancelled are specified.
6) **Rules and laws** – rules and laws of domestic country are applied on its territory to every carrier.
7) **Dispensation from tariffs and custom charges** of planes and spare parts, catering, documents. Transit passengers pass simpler custom control.
8) **Airport charges** are equal for all carriers.
9) **Regulation of capacity and affirmation of schedule.** Equal possibilities for both carriers should exist. Each carrier should take into account interests of the other one. Together they should provide socially desirable level of transportation under "reasonable" load factor. Total volume of transportation by each carrier should be approved by both countries' authorities. Schedule should be given to authorities for confirmation no less than 90-30 days before starting of operations.
10) **Acceptance of certificates**.
11) **Representative.** This article is present if representative office is allowed.
12) **Air traffic tariffs (fares).** Fares are set taking into account costs, service, "reasonable" level of profits, and other carriers' fares on similar routes. If air traffic association that includes both carriers (e.g. IATA) has set tariffs, they'll be used as a base line, otherwise carriers negotiate over tariffs. Tariffs should be approved by both countries' authorities.
13) **Accounts.** Foreign airlines have right to transfer their profits abroad without any restrictions.
14) **Air traffic safety**.
15) **Statistic provision**. Airlines have to provide the same statistic data for both countries' authorities.
16) **Consulting and changes**.
17) **Arbitrage.** In case governments weren't able to reach agreements themselves, this can be done by arbitrage consisting of 3 arbiters – one

from each country and the head of arbitrage from a 3rd country. Its decisions are mandatory and cannot be changed.

18) **Changes in agreement**
19) **Abatement**. One of the countries can send another and ICAO a notification of abatement, and agreement is cancelled a year after the second side receives this letter.
20) **Registration in ICAO**. All agreements are registered in ICAO.
21) **Commencement**.As soon as each country notifies another about implementation of conditions that are needed to start the agreement, it is coming into effect.

Below are the brief contents of some bilateral agreements.

Country	Air freedoms	Date of signing	Comment
Egypt	1,2,3,4	22.12.92	Cities for commercial stops specified in amendment
Iran	1,2,3,4; 5th – with carriers' and authorities' agreement	9.07.93	Commercial stops specified in amendment (table of routes). No cabotage (in the zone of war actionas – with special permission). Only one appointed carrier from each country.
Italy	1,2,3,4; 5th – by separate agreement.	2.05.95	One appointed carrier from each country. Routes: Ukrainian city-Rome with one stop-over in Europe possible. Each carrier can perform up to 3 flights per week on B-737/400, M80 or similar plane. More flights can be negotiated between both carriers and authorities.
Austria	1,2,3,4	15.06.94	Table of routes – any points in Austria and Ukraine. 5th freedom – by permission of gov-t
Georgia	1,2,3,4	13.04.93	Routes: Kyiv-Tbilisi and back. Tariff regulation – airlines can charge only published fare. All discounts are to be approved by other carriers and authorities.
Armenia	1.2.3.4	17.06.95	Only one airline from each country can be appointed at each route.
Belarus	1,2,3,4; 5- by separate agreement	17.07.95	Several airlines can be appointed. Route: any Belarussian or Ukrainian cities and cities outside these countries. Only one airline from each country can be appointed at each route.
Latvia	1,2,3,4	23.05.95	Several carriers can be appointed. Routes: cities in Ukraine- transit cities – Riga. No

			commercial load/unload in transit cities is permitted.
Lithuania	1,2,3,4	7.07.93	Duration of agreement - 10 years. Route permitted – Kyiv- Vilnius. Other routes can be permitted upon negotiations. Transit points and points outside the Ukraine or Lithuania can be included into a route. But it should begin or end in one of these countries.
Malta (with USSR)	1,2,3,4,5	8.10.81	Route: Malta-European cities-USSR cities – other cities (to be agreed upon later). Cities in USSR or Malta should be included into a route.

Russia	1.2.3.4; 5 – agreement of aviation authorities	12.01.94	Routes: Russian carriers: Moskow, St-Petersburg, Khabarovsk, Murmansk, Novosibirsk – interim cities – Kyiv, Simferopol, Odessa, Lviv, Mykolaiv – cities outside Ukraine. Ukrainian carriers: Kyiv, Simferopol, Odesa, Lviv – interim cities – Moskow, St.Petersburg, Rostow. Other endpoints – upon agreement of aviation authorities. Three appointed carriers from each country.
Hungary	1,2,3,4,5	19.05.95	One or several carriers. Capacity will be defined according to the need in local, international and transit transportation.
Israel	1,2,3,4	20.04.94	Capacity established according to expected demand and equally divided between carriers. Only one carrier can be appointed from each side.
UK	1,2,3,4	10.02.93	One or more appointed carriers. 5th freedom can be allowed by authorities. Routes: cities in Ukraine (UK) – transit points – cities in UK (Ukraine) – other cities.
Estonia	1,2,3,4	6.07.93	One carrier per route from each country.
Poland	1,2,3,4; 5-separate agreement	20.01.94	One or more carriers. Routes: Ukrainian cites-Polish cities – other countries or Polish cities-Ukrainian cities – other countries.
Kazakhstan	1,2,3,4	22.02.93	Discounts from tariffs should also be permitted by both authorities
China	1,3,4; 2 – by separate agreement	30.10.92	Temporary protocol – permission to perform flights Kyiv-Bejing by 2 appointed carriers.
United Arab Emirates	1,2,3,4,5 5th freedom needs additional agreement	23.06.87	Between USSR and UAE. Routes: for Soviet carriers – Soviet cities – any transit points – Abu-Dhabi, Dubai, Sharja, Ras al Haima, Fujaira – Africa, South-Eastern Asia, Australia. UAE carriers: cities in UAE – any transit points – Moskow, Leningrad, Kyiv, Yerevan – Europe, America.
Switzerland	1,2,3,4		One carrier. Based on old agreement with USSR.

Appendix 2. **Airports.**

The following table describes some of the Ukrainian airports. Class of the airport is defined from highest to lowest from A to E. Class of an airport depends on the number of length of runways, quality of navigation equipment and ground facilities, and consequently, on the type of planes that can be handled at it.

	Airport	**Class**	**Number of Runways**	**Runway Length/m**	**Jet Type**
1.	Kiev-Boryspil	A	2	3,500	B-737 A320/310
				4,000	B-767/747 A330/340
2.	Dnipropetrovsk	B	1	2,500	B-737, F70
3.	Donetsk	C	1	2,500	Tu-154
4.	Zaporizhya	C	1	2,500	Tu-154
5.	Ivano-Frankivsk	C	1	2,500	Tu-134; IL-62
6.	Kiev-Zhulyany	E	1	1,800	An-24
7.	Kryvyi Rih	C	1	2,500	Tu-154
8.	Luhansk	B	1	2,840	Tu-154
9.	Lviv	C	1	2,510	B-737, Yak-42, IL-62
10.	Mykolaiv	C	1	2,550	Tu-154, IL-76
11.	Odesa	B	1	2,800	B-737, D80, IL-76
12.	Rivne	C	1	2,626	Tu-154, IL-76
13.	Simferopil	A	2	2,200	B-737,
				3,200	IL-62, IL-86
14.	Uzhgorod	E	1	2,040	Yak-42
15.	Kharkiv	C	1	2,220	Tu-134
16.	Chernivtsi	C	1	2,200	Yak-42

Source: The Commercial Service, U.S. Embassy, Kyiv

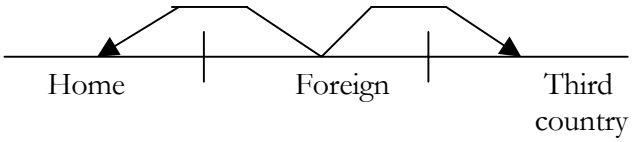
Appendix 3. **Air Freedoms.**

Rights that a foreign country grants to home (on a mutual basis).

First freedom.

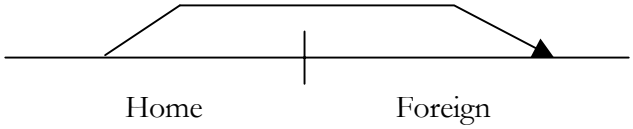
Right to fly over Foreign's territory.

Second freedom.



The right to make a technical stop in another country.

Third freedom.

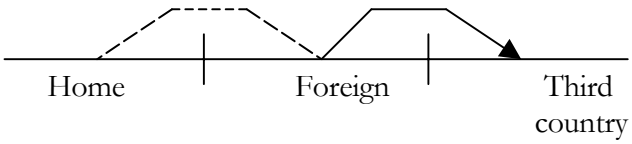


To carry freight and passengers from home to foreign.

Fourth freedom.

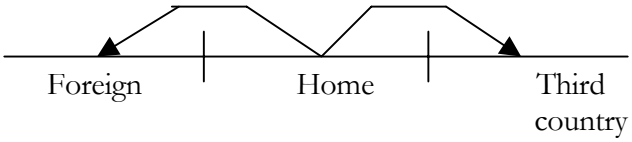
To carry freight and passengers from foreign to home country.

Fifth freedom.



To carry freight and passengers between foreign and a third country on a route originating/ending at home.

Sixth freedom.

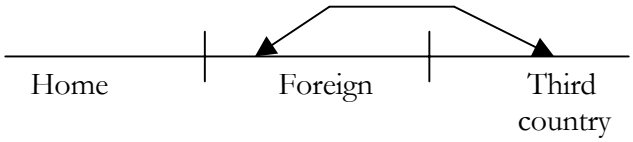


To carry freight and passengers between foreign and third country on a

route passing through home.

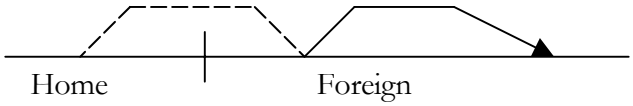
Seventh freedom.

To carry freight and passengers between foreign and third country without connection with home country.



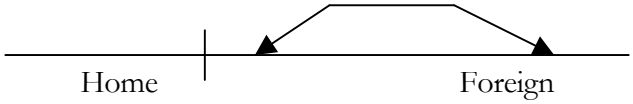
Eight freedom (cabotage).

To carry freight and passengers within foreign country on a route originating from home country.



True domestic.

To carry freight and passengers within a foreign country with no connection to the home country.



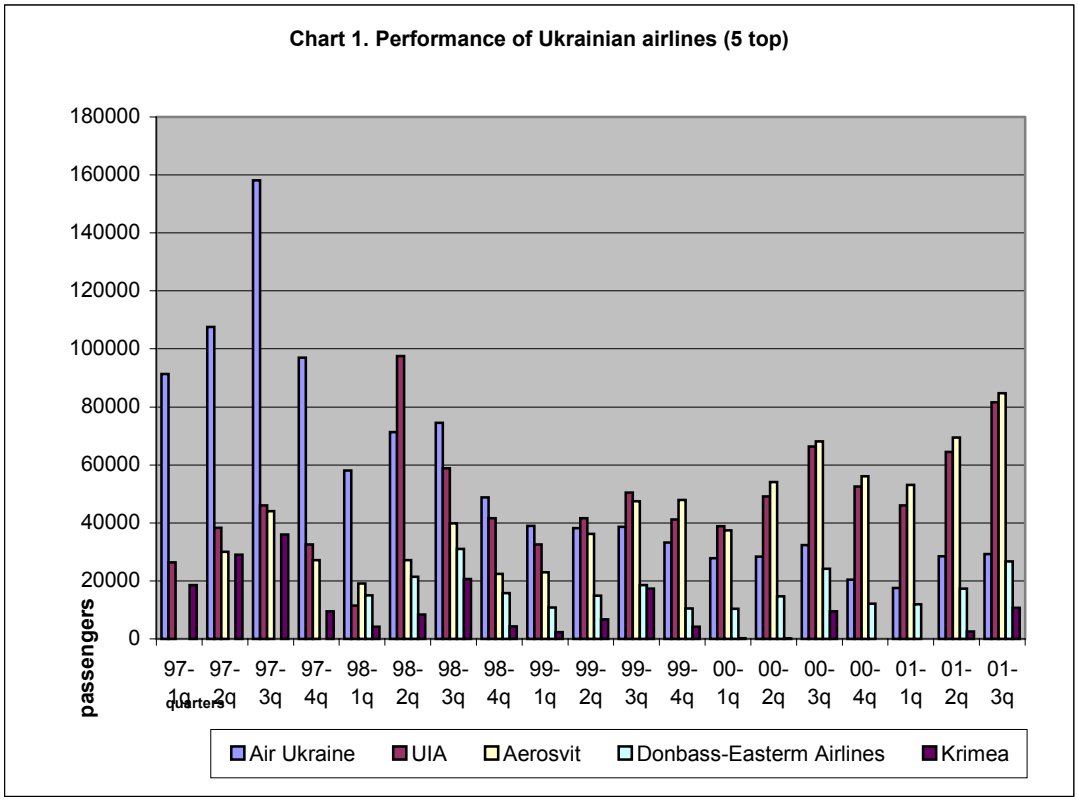
Source: Association of European Airlines/European Commission

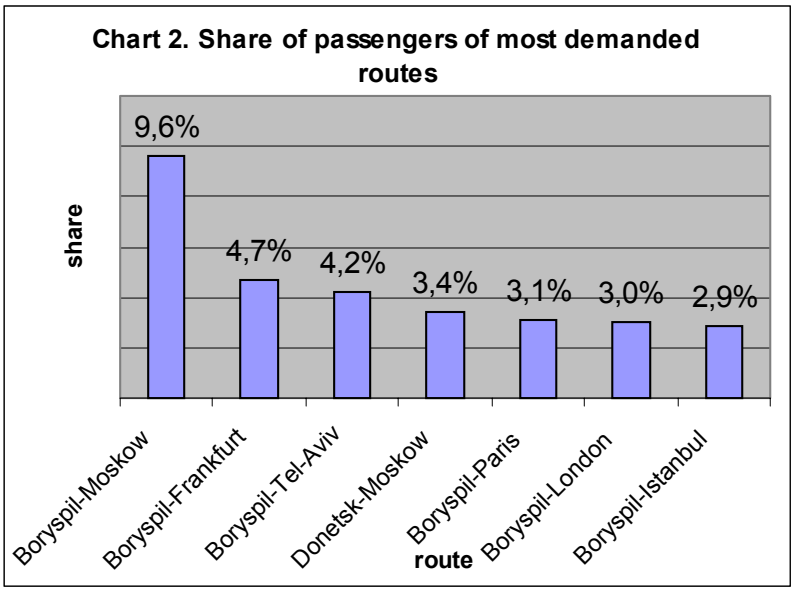
Appendix 4. **Aircrafts.**

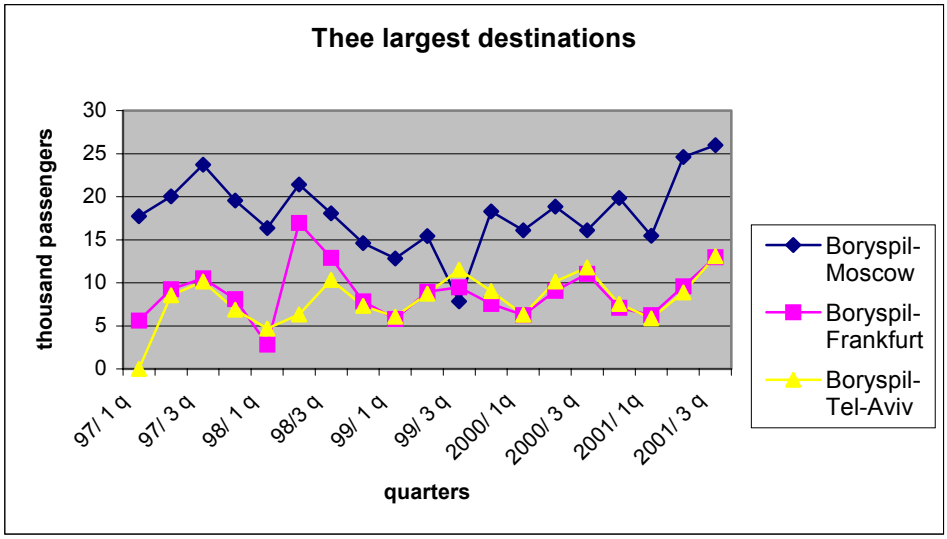
The following table represents the distribution of Ukrainian fleet by age as of the year 2000. (Source: Derzhkomstat)

Type of aircraft	**Total quantity**	**Below 3 years**	**3-5 years**	**5-10 years**	**Older than 10 years**
Il-18	3				3
Il-62	7				7
Il-76т	6			1	5
Tu-134	19				19
Tu-154	24			1	23
An-2	345			14	331
An-24	70				70
An-26	19				19
An-30	6				6
An-32	3			3	0
Yak-40	36		1		35
Yak-42	27			7	20
L-410	22			1	21
Mi-2 (helo)	217			12	205
Mi-8 (helo)	72			4	68
Ka-26 (helo)	50				50
Other	28	2	1	3	22
Total	954	2	2	46	904

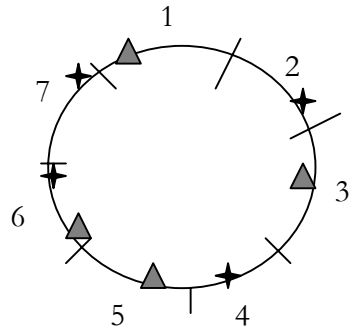
Appendix 5. **Some indicators of Ukrainian airline market.**



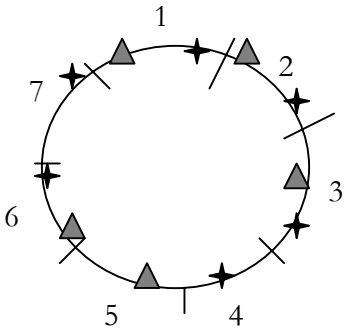



Thee largest destinations
thousand passengers
30
25
20
15
10
5
0
97/ 1 q
97/ 3 q
98/ 1 q
98/3 q
99/ 1 q
99/ 3 q
2000/ 1q
2000/ 3 q
2001/ 1q
2001/ 3 q
quarters
Boryspil-Moscow
Boryspil-Frankfurt
Boryspil-Tel-Aviv

Appendix 6. **Distribution of flights on some routes**



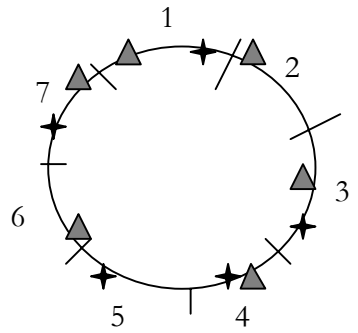
Amsterdam



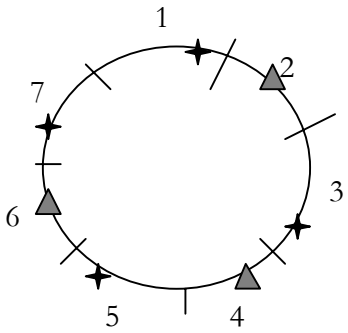
2000 2001

✦ - KLM

▲ - UIA



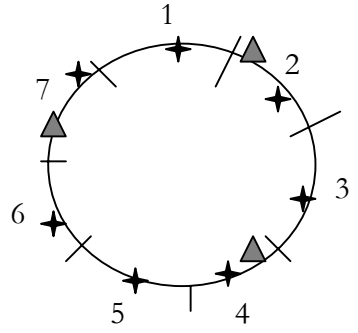
Budapest



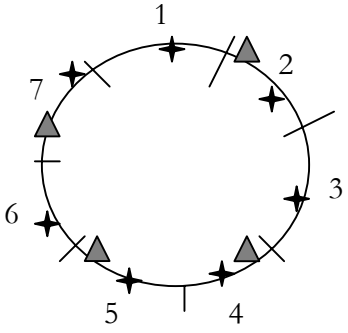
2000 2001

✦ - Malev

▲ - Aerosvit



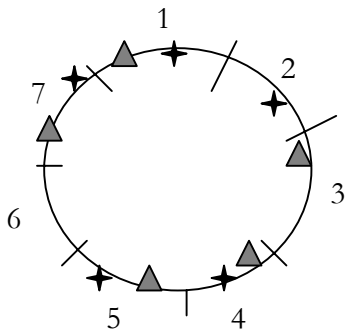
Vienna



2000 2001

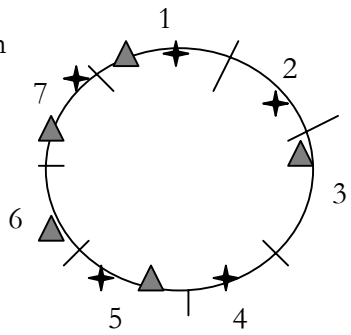
- Austrian Airlines

- UIA



2000

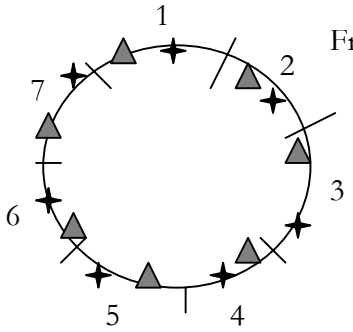
London



2001

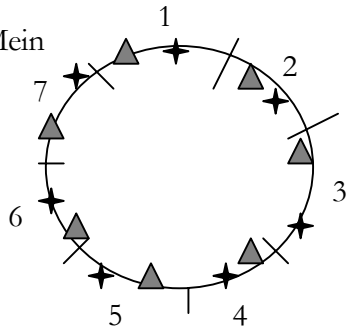
- British Airways

- UIA



2000

Frankfurt-am-Mein



2001

- Lufthansa

- UIA

Appendix 7. **Main airline alliances of the world.**

Name	Participants	Total volume of transportation, million people*	Total passenger-kilometres performed, billion*	Total volume of sales, million dollars
		(% of world traffic)		
Star Alliance	United Airlines, Lufthansa, Singapore Airlines, All Nippon Airways, Thai Airways International, Varig, SAS, Air New Zealand, Ansett Australia, Mexicana, Austrian Airlines, British Midland	292.7 (18.8)	593.6 (21.3)	69.6
One-world	American Airlines, British Airways, Quantas, Cathay Pacific, Iberia, Lan Chile, Finnair, Aer Lingus	199.3 (12.8)	465 (14.6)	50
Wings	KLM, Northwest Airlines	71.6 (4.6)	177.4 (6.4)	16.8
Quali-flyer	Swiss, Sabena, Turkish Airlines, AOM, TAP Air Portugal, Air Europe, LOT Polish Airlines, Crossair, Volare, Air Littoral, Portugalia	52.3 (3.4)	100.7 (3.6)	16.2

* 1999 data.

Source: ATO journal (Russia).

Appendix 8. **The derivation of Nash equilibrium under regulated prices.**

1. Reaction function in frequencies have inverted-U shape.

Recalling expression (1),

$$\pi_i = (p_i - c)\, Dn_i/n - n_i F, \;\; i=1,2;$$

FOC with respect to own frequency, taking rival's frequency as given:

$$\partial\pi_i/\partial n_i = D(p_i - c)n_j/(n_i + n_j)^2 - F = 0, j = 2,1.$$

From the first order condition we get reaction functions

$$n_i = (n_j(p_i - c)D/F)^{1/2} - n_j,$$

slopes of which are determined as

$$\partial n_i/\partial n_j = (D(p_i - c)/F)^{1/2}/(2n_j^{1/2}) - 1,$$

which is positive if $n_j<D(p_i - c)/2F$ and negative if $n_j>D(p_i - c)/2F$, so reaction functions have inverted-*U* shape. This means that in response to rival's increase in frequency, the airline first increases and then decreases its own frequency. The result is contrary to that of Schipper et al. because of price regulation assumption.

At first airlines compete in frequencies, but as frequencies become sufficiently high, demand for an individual flight becomes too small, making a flight unprofitable. So one of the airlines backs up on frequency. Which one – is a separate question considered below.

2. Relative positions of the reaction functions' maxima.

First of all, when $\partial n_i/\partial n_j = 0$, $n_i = D(p_j - c)(\sqrt{2} - 1)/2F$.

Now for definiteness let's use index notation of airlines, where $U_1>U_2$, $p_1>p_2$, i.e. airline 1 is the higher-quality airline (a reasonable would be to assume that it is a foreign airline).

The maximum of the reaction function of the first airline (R1) is the point denoted (E; B), where

$$B=D(p_1 - c)/2F; \quad E = D(p_1 - c)(\sqrt{2} - 1)/2F.$$

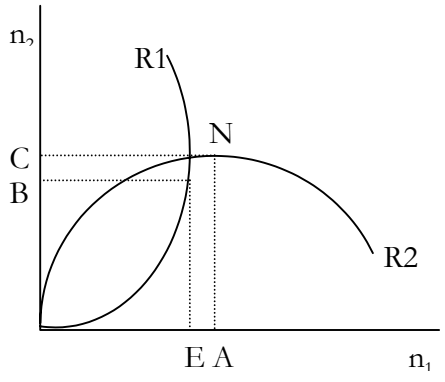


Figure A8.1. Reaction functions of the airlines

The maximum of the second reaction function (R2) is at the point (A; C) with

$$A = D(p_2 - c)/2F;$$

$$C = D(p_2 - c)(\sqrt{2} - 1)/2F.$$

To depict the reaction functions correctly, we must know whether point B is higher or lower than point C and whether E is to the right or to the left of A. Consider three cases.

1) $B<C$ or $(p_1 - c)/(p_2 - c) < (\sqrt{2} - 1)$, and hence, because $\sqrt{2} - 1<1/(\sqrt{2} - 1)$, $A>E$, as depicted in the figure A8.1.

By substituting its coordinates into R2 function, we find that the point (E; B) doesn't lie on the R2 curve unless $(p_1 - c)(p_2 - c) = \sqrt{2} - 1$. In the figure point (E;B) lies below the R2 curve.

2) $B>C$ or $(p_1 - c)/(p_2 - c) > (\sqrt{2} - 1)$. This case can be divided into three more cases: A>(=<)E when $(p_1 - c)/(p_2 - c) <(=>1)/(\sqrt{2} - 1)$.

3) $B=C$ or $(p_1 - c)/(p_2 - c) = \sqrt{2} - 1<1/(\sqrt{2} - 1)$ and thus $A>E$.

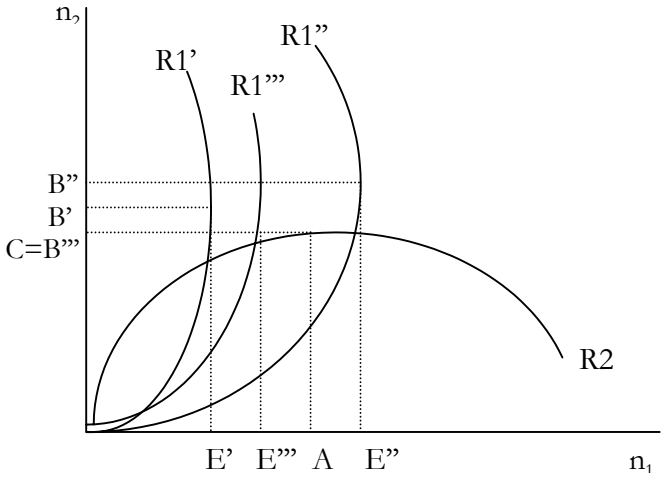


Figure A8.2. Reaction functions of the airlines (continued)

Cases (2) and (3) are depicted in the figure A8.2. Here, curves R1' and R1" represent cases when $B>C$ and $A><E$ respectively. The case when $A=E$ is not depicted, but the curve lies between R1'" and R1". The curve R1'" represents the case B=C.

The Nash equilibrium in prices is found at the intersection of the reaction functions.

At the equilibrium

$$n_i^* = (D/F)(p_j - c)((p_i - c)/(p_i + p_j - 2c))^2.$$

3. Equilibrium profits and government regulation.

Note that at the Nash equilibrium the airline that has higher price/quality should have higher frequency. In this case it also has higher profits:

$$\pi_i^* = (D/F)(p_i - c)^3/(p_i + p_j - 2c)^2.$$

If the government forces the first airline to set $n_1 = n_2^*$, profits of the first airline decrease and profits of the second airline rise, which can be easily verified by substituting appropriate frequencies to the profit expressions and comparing the results.

Whether gain in profits for the second airline is greater than, equal to or smaller than the loss to the first airline, depends on the sign of $\Delta\pi_2 + \Delta\pi_1$, and after simplification on whether the following expression

$$(p_2 - c)^2 + (p_1 - c)(2p_2 - c - p_1)$$

is greater, equal or less than zero.

Most probably, if $p_1 - p_2$ is not too large, $\Delta\pi_2 + \Delta\pi_1$ will be positive. It can be shown that n_2^* is an optimal choice if the government wants to maximize profits of the national carrier (airline 2).

4. n_2^* is an optimal choice for a regulator.

To see this consider figure A8.3.

In this figure, isoprofit curves π_1 and π_2 of the two airlines are depicted. They are tangent to reaction functions at the Nash equilibrium (point N). When we shift isoprofit curves closer to the corresponding axes (inside the domain), profits rise.

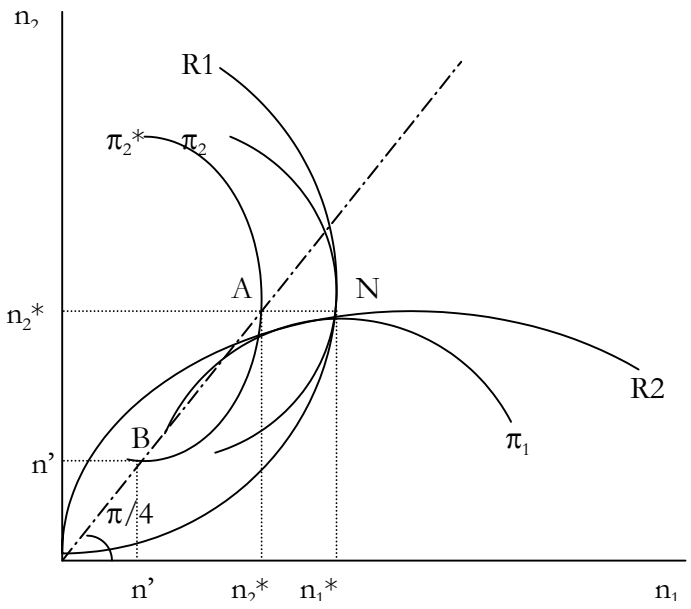


Figure A8.3. Maximization of π_2 by the government

For example, consider moving the π_1 curve to the n_1 axis. With the same n_1, n_2 falls and thus profits of the first airline must rise.

Setting $n_1 = n_2^*$, the government moves home airline to a higher isoprofit curve, and the foreign airline to a lower one; and rise in profits in the first case will most probably be greater than loss of profits in the second case.

It can easily be seen that choosing any other frequency as an optimum, at least near the Nash equilibrium, the government will not be able to move domestic airline to the curve π_2^*. For example, for the $n_1=n_2=n_2^m$, by n_2^m denoting the point where R1 reaches maximum, the difference between π_2^* and π^m is positive if

$$(p_1 - c)[(p_1 - c)(p_2 - c) - 1] + (p_2 - c)^3 + (p_2 - c)(\sqrt{2} - 1) > 0,$$

which holds because in reality price exceeds marginal cost by more than one monetary unit. For higher values of n_2, a move to a lower isoprofit curve is obvious.

For frequency lower than at the Nash equilibrium, the situation is not so clear cut but it well may be the case depicted in the figure where points A (n_2^*, n_2^*) and B(n', n'), with $n' < n_2^*$ lie on the same isoprofit curve.

When choosing between points like A and B government will probably prefer A because at this point consumes get more service.