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Overview of air transport and current and potential air connectivity gaps in the CESE region

Paper B

Final report

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Executive summary

Introduction and background to the study

Given the fragile financial state of airlines in the Central Eastern and South-East European (CESE) market, a case study has been developed to assess the social and economic effects following the bankruptcy of Malév Hungarian Airlines in February 2012. In particular, the study analyses the consequences of Malév's bankruptcy with a focus on the impacts in relation to air connectivity to/from Hungary and in relation to consumer welfare, through discussions with key stakeholders and the use of econometric analysis of quantitative data. The study presents a qualitative analysis, assessing the economic and social consequences of Malév's bankruptcy, and an econometric analysis, focused on the effects of the airline's collapse on consumers.

The rationale behind scrutinizing the Malév experience is that Malév's collapse might foreshadow the future demise of further carriers in the CESE region, with a number of financially weak carriers operating in the CESE market 'urgently' seeking additional funding and/or new investors. This fragility of airlines in the CESE market raises questions regarding what could happen in the region should an airline collapse, in terms of connectivity and the impact on passenger experience.

Malév, and its impact on Hungary, presents an appropriate regional example of what could happen in the event of a country's network flag carrier entering bankruptcy. It provides a clear illustration of how governments could cope with the severe impact an airline bankruptcy may have on a country's economy and passenger experience, helping authorities to anticipate the potential repercussions of such an airline default event.

Economic and social consequences of Malév's bankruptcy

Overview

Malév was declared bankrupt in February 2012, with all but 540 of Malév's 2,600 employees being laid off. The follow on effect of the bankruptcy triggered further redundancies at Budapest Airport Ltd, as well as at the company's suppliers. Trade unions have suggested that most of the former employees are still out of work. These consequences point to the meaningful role Malév played in the Hungarian economy and the possible effects of Malév's failure on both air service connectivity and quality in Hungary. The study assesses the socio-economic impacts of Malév's collapse.

Analysis

Research and analysis revealed the main socio-economic consequences of the Malév bankruptcy to be as follows:

Significant reduction in direct employment in the Hungarian air transport sector

Malév's bankruptcy had a substantial impact on employment in the Hungarian air transport sector. Prior to Malév's bankruptcy (i.e. 2011), the civil aviation industry in Hungary employed 7,126 people.[1] This includes air transport activity (i.e. Malév, Wizz Air and other smaller operators); service activities incidental to air transport (i.e. air traffic control, operation of terminal facilities and ground handling operations (excluding baggage handling)); and repair and maintenance of aircraft (i.e. Aeroplex Central Europe, LH Technik and other smaller operators). Malév directly employed around 36% of workers in the Hungarian civil aviation industry. Subsequent to Malév's bankruptcy, only a small number of these employees managed to find similar positions in Hungary.

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1 Eurostat

In contrast, it was easier for administrative staff to be employed in a different company and sector, with about 50% finding employment within 6 months (but in many cases at a lower salary). This was mainly a result of the over-supply of professionals and substantial restructuring that was implemented by Malév's subsidiaries following the bankruptcy. State owned corporates helped to re-employ a number of the administrative staff (rail and public transport companies). All the subsidiaries adopted immediate measures to cut costs by drastically reducing wages on average by 15-20%.

The work prospects were limited with most former Malév employees feeling compelled to leave the civil aviation sector to look for employment opportunities in a different country and/or sector – with specialised skills (aviation) that are not often transferable to another industry.

Interviews with local experts confirmed that the collapse has affected not just Malév, but also its subsidiaries, business partners and suppliers.

Impact on Malév's subsidiaries

Malév's subsidiaries were all highly reliant on Malév's operations to generate revenue. Malév's bankruptcy therefore substantially affected the subsidiaries' earnings and financial prospects. The main subsidiaries are as follows:

- **Malév Ground Handling Ltd. (MGH)**: the company was the largest handling service provider at Budapest Airport, with about 700 staff and operating revenues close to HUF 10 billion (EUR 35-40 million). About 50% of total revenues were generated by Malév. MGH initiated a mass redundancy programme, laying off about 250 of its employees following Malév's collapse.
- **Aeroplex Central Europe Ltd. (ACE)**: a maintenance provider, which became unprofitable during the last years of Malév's operation and deteriorated further after Malév collapsed. The government purchased the firm's shares and injected equity into the business, but the company is still posting substantial losses despite capital injections. The former subsidiary has had no stable clients since Malév's demise and is now performing ad hoc base maintenance activities.
- **Malév Air Tours (MAT)**: a medium-sized travel agency present in both the inbound and outbound market. It used to generate HUF 1.5-2 billion (EUR 5 million) revenue per year before Malév's collapse. Management significantly reduced staff and downsized its operation after Malév's collapse. It has been privatized and transformed into a mainly inbound service provider in a niche market (patients from abroad travelling to Budapest for dental services).
- **Pannon Air Cargo (PAC)**: a customs and local cargo service provider which was in close partnership with Malév's cargo operations, but was less dependent on the parent company than the above subsidiaries. After Malév's collapse the company was privatised. The company implemented a restructuring plan by scaling down its operations.
- **Air Budapest Club (ABC)**: a small labour sourcing company. This subsidiary used to outsource flight attendants to Malév, but due to legislation changes it was not possible for affiliated companies to provide this service any longer. It remained in this market, but was already substantially affected by this legislation change before Malév's bankruptcy and was forced to substantially reduce its operations. Later it was mandated to manage former Malév staff.

Further investigation has also shown that Malév's collapse caused severe supply chain disruption with a few medium-sized suppliers such as BAS Kft (catering), which had been strongly or fully dependent on Malév, shutting down operations.

In addition, the collapse has had important repercussions on aircraft lessors and banks due to unpaid lease rentals and aircraft value losses, combined with the difficulty in finding an alternative lessee in an acceptable period of time to avoid further loss. Malév had been leasing 17 Boeing NGs from ILFC, one Boeing NG from Macquarie and four Q400s from SAS. The accelerated payment of the aircraft leases also likely contributed to Malév's collapse.

Impacts on Budapest Liszt Ferenc International Airport

After the bankruptcy of Malév, traffic at Budapest Airport changed substantially. Wizz Air and Ryanair opened many 'new' destinations, while other network carriers either increased flight frequencies or increased aircraft capacity on their existing flights (through revised seat configurations).

Air traffic movements dropped by a quarter, while the number of transfer passengers was practically wiped out. However, the decrease in passenger traffic in 2012 was much lower than expected given the change in airline mix. The current situation now appears to be more commercially robust, with the airport relying on several medium-sized, solvent carriers rather than one dominant airline with continual cash flow problems.

A key issue that remains is the lack of long-haul passenger flights. Budapest has never been an international hub for long-haul traffic, but until 2012 there were direct flights to Beijing (operated by Hainan Airlines, code-shared by Malév) and New York (seasonally operated by American Airlines, code-shared by Malév). In the years before 2012, Malév operated its own flights to New York, Toronto and Bangkok, and Delta also had a seasonal connection to New York.

Impacts on the air cargo market

Malév was the dominant carrier in the Hungarian market, with approximately 30% of the Hungarian air cargo market. Following its collapse a large share of the cargo market activity was not replaced by other airlines. Indeed, the low cost carriers that replaced Malév on the most attractive routes – Wizz Air and Ryanair – do not provide any cargo service. As a result, network carriers operating in the country up-gauged their aircraft allowing for a small amount of additional cargo capacity, while further market share was gained by integrated service providers such as TNT and DHL.

This outcome was accentuated by the withdrawal of long-haul operations from Budapest by US carriers (American and Delta), which had originally started to operate these routes soon after Malév's decision to focus on short-haul routes and to discontinue long-haul operations. Hainan Airlines, which was flying to Beijing and beyond in China, also decided to leave the market, reportedly due to the lack of a local feeder airline. These decisions by long-haul operators significantly affected the cargo market.

As a result of the change in cargo supply, there was a shift in the demand with most companies transiting their goods via the main European hubs (rather than Budapest). Goods are then delivered to Hungary by road, thus reducing the requirement for short-haul carriers to connect Budapest Airport with the main airport hubs (this severely limits the amount of cargo passing through the airport). The few resilient short-haul network carriers in the Budapest market that do provide air cargo service now have a dominant position, resulting in air cargo tariffs increasing by 30-40% on average.

Changes to market

Low cost carriers (LCCs), in particular Wizz Air and Ryanair, benefited the most from the exit of Malév from the market. Wizz Air was already the second largest carrier in the Hungarian market and was naturally well-positioned to fill the void left by Malév. Ryanair acted quickly and took up a number of slots at Budapest Airport, becoming the second largest carrier in Hungary.

LCC penetration in Hungary prior to Malév's grounding stood at a relatively modest 24%, down from as high as 28% in 2005. Following Malév's collapse, LCC penetration in Hungary rapidly increased to about 40% and in future may surpass 50% if current growth trends continue.

The increased penetration of LCCs has implications in terms of connectivity and flight frequencies as LCCs operate higher capacity aircraft compared to Malév, making it difficult to sustain the number of frequencies given current market demand.

Passenger impacts

Time sensitive passengers, such as those travelling for business purposes, are concerned with reaching their destination in the shortest possible time. They usually have little flexibility in terms of time of departure or arrival, and they require the possibility to change their reservations at short notice. Time sensitive passengers are prepared to pay more to ensure they will always be able to travel on the most convenient flight.

The analysis suggests that time-sensitive passengers have been impacted to the greatest extent by Malév's bankruptcy. Several routes are no longer operated by any network carriers; and there has been a substantial reduction in the flight frequency for the routes that are still serviced by these network carriers. LCCs tend to schedule flights at less convenient times for business passengers in order to maximize aircraft utilization and minimize airport charges.

Further analysis was conducted on airline schedules to evaluate the number of destinations that could be reached for a business meeting in a day trip to or from Budapest before and after the Malév bankruptcy. One of the main criteria being that flights need to provide the possibility to depart and arrive on the same day on a sample weekday, allowing at least four hours during business hours at the destination. Results show that the number of destinations that can be reached in a day trip has declined in both directions for both the summer and winter schedules between 2011 and 2013, with a particularly strong decline seen in the number of feasible day trip destinations from Budapest during the summer schedules.

Stranded passengers

The Hungarian Government adopted a Decree (5/2012) on 31 January 2012 providing the possibility to claim for refunds for passengers with tickets for outbound or inbound flights scheduled between the 3rd and 6th February; and for passengers with a return ticket, the outbound flight needed to be before the end of February 2012. The Decree did not provide for re-routing and affected only a small portion of passengers.

In order to complete their travel initially booked on Malév, passengers had to find and purchase another air ticket: either "rescue" fares offered by some airlines or completely new tickets at market price.

For Malév tickets initially purchased via a travel agent holding an IATA accreditation, IATA required agents to remit to IATA all amounts resulting from the sale of Malév tickets in January and up to early February 2012. IATA indicated that it had negotiated an agreement with Malév, under which the money collected from agents would be used to refund passengers. IATA has received some 100,000 requests for refunds (this only concerns tickets booked via an IATA accredited agent). Starting from March 2012, however, IATA indicated that it needed the approval of the bankruptcy administrator to process refunds as it encountered difficulties in obtaining approval (which also increased the risk that passengers receive no refund under the IATA Agency Programme). This process has not been concluded to the full extent at the time of writing the current analysis.

Connectivity impacts

Strong growth occurred both for business and leisure connectivity in the Hungarian market until 2006 when connectivity growth stagnated. Following Malév's bankruptcy, connectivity has declined. While overall available seat capacity was maintained in quantity, flight frequency and the value of the destination, both in terms of the destination airport's size and connectivity as well as the destination city's business connectivity, declined due to replacement capacity being directed to smaller, less connected secondary airports. Flights are also now more focused on thicker routes outside the CESE region (primarily EU15) as LCCs' business models tend to favour routes that require higher capacity aircraft leading to better operating margins.

Tourism impacts

Inbound air travellers generate positive economic effects because of their expenditure on services and products in the local economy. These travellers can be divided into three categories according to their main purpose of travel: Leisure (visitors which travel for tourism but also for shopping, medical treatment, spa and wellness); VFR (visiting friends and relatives); and Business (travelling for work but also for business tourism, conferences, etc.)

In recent years, even before Malév's collapse, the Hungarian tourism sector had shown a positive trend. In 2012,[2] following the collapse of Malév, the number of nights spent in hotels and similar accommodation by foreign visitors rose year-on-year by 13.5%. The increase was more marked with regards to European tourists, who spent almost 8.5 million nights in accommodation in Hungary (14.1% increase on previous year). In addition, tourism from non-European countries presented an increasing trend, marking a 10.3% increase on the previous year. Tourism from non-European countries accounts for approximately 15% of total foreign tourism in Hungary.

Despite the quantitative facts concerning passenger numbers at Budapest Airport, the demographics of passengers has changed. The leisure and VFR traffic substituted a substantial proportion of business traffic, which is assumed to have generated a greater economic impact for Hungary.

Additional analysis shows that the high yield tourism sector has been severely affected and almost disappeared from the local market. This may be related to the reduction of long-haul destinations served from/to Budapest Airport subsequent to the collapse of Malév and there is reason to believe that without a feeder airline for long-haul services this situation will be difficult to reverse.

Leisure visitors and VFR travellers did benefit from the Malév collapse with the increased presence and market share of low cost carriers.

It is difficult to assess tangibly whether the Hungarian tourism industry has benefited from Malév's bankruptcy. Leisure tourism has increased in terms of number of visitors, but the real direct effects on the economy in terms of local expenditure seem to be negligible.

Prospects for establishing a new airline

Sólyom (Falcon) Hungarian Airways had planned to commence service in Hungary with six aircraft in August 2013. The proposed carrier had ambitious growth plans, as it sought to grow its fleet to 25 aircraft by the end of 2014 and 50 by the end of 2017, including 10 wide body aircraft. It expected to employ around 700 employees initially, increasing to 3,000 depending on its growth trajectory. The carrier, while positioning itself as the new national airline, was not meant to have any state involvement; rather it had support from Middle Eastern investors. The carrier expected to handle around eight million passengers by 2017. Similarly, Hungarian World Airways attempted to establish itself as the new national carrier. Both projects failed before commencing any commercial operation.

While Hungary's government continues to believe that the country can support a full-service network carrier, this may ultimately prove difficult to achieve. A new start up airline would need to firstly assess whether there is an economic case supporting growth in the country; which is one condition (amongst others) to attract investors (airline investors and non-airline investors). However, Hungary appears to be one of the bright spots in the region when it comes to air travel (GDP per head, propensity to travel and aircraft orders). Nonetheless, LCCs have changed the aviation landscape in Hungary especially since Malév's collapse, and have a substantial market share that may make market entry for network carriers a challenge.

Impacts of air traffic rights and EU designation

EU designation provides that external partners will accept the designation by an EU Member State of any properly licensed EU carrier, established but not necessarily owned and controlled in that Member State,[3] to operate traffic rights available under their air service agreements with the EU or its Member States.

Unlike other cases, the issue of EU designation for Hungary has involved more than just bringing Air Services Agreements (ASAs) in line with EU law. It has been a critical issue following the collapse of Malév, since Hungary does not have any airline which is owned and controlled by Hungarian interests to designate. The

2 Note that tourism figures for 2013 are not yet available.

3 But owned and controlled by EU or EEA interests.

airlines that have shown interest in designation under ASAs between Hungary and non-EU states are Wizz Air and Travel Service Hungary, neither being Hungarian owned and controlled.

Within the common aviation area in Europe, any EU-carrier may operate services between any EU destinations if there are slots available; therefore most European connections were immediately recovered following the collapse of Malév. However, for certain non-EU destinations, bilateral aviation agreements regulate the services between two States in terms of capacity and carriers that can operate. Markets such as Russia (which had not yet agreed to EU designation clauses, and hence was not obliged to accept the designation of carriers with EU, but not majority Hungarian, ownership), Turkey, Ukraine and Israel were left for a time with limited services operated by third country carriers or no services at all before EU designation was negotiated with the countries concerned and traffic rights were allocated through the national procedure.

Econometric analysis of impacts

We have undertaken econometric analysis to assess the effects of Malév's bankruptcy on three determinants of the Hungarian airline markets performance: fares, capacity and demand. Malév's bankruptcy has the potential to:

- Reduce competition in the market, which in turn leads to an increase in fares.
- Lower levels of capacity, which in turn leads to a reduction in connectivity.
- Lower the overall demand for aviation.

The international nature of the aviation industry means that it is exposed to external economic shocks (e.g. changes in global demand, natural disasters, etc.). This can lead to volatility in cash flows, profits and in Malév's case bankruptcy. This paper does not seek to evaluate the causes of Malév's bankruptcy – instead it is focused on the consequences.

In the broader European context, other national carriers may require state aid to remain operational in the future, so an analysis of Malév's bankruptcy on key market determinants has the potential to provide a basis for future state aid decisions. Opponents to the use of state aid argue that 'most airlines continue to operate through bankruptcy resolution and that even a complete shutdown of a major carrier, which rarely occurs, would stimulate expansion by other airlines to replace its abandoned flights'.[4] Thus, the impact on fares and capacity would be minimal. Consequently, it becomes important to understand the market impact of Malév's bankruptcy. The discussion relating to state aid is carried out in the backdrop of the 2007 financial crisis – the European fiscal compact places restrictions on government deficits and debt, so bailouts of European airlines need to be considered against other fiscal priorities.

This debate highlights the need to distinguish between the effects of adverse economic shocks on the airline market and the causal consequences of airline bankruptcy. Econometric techniques give an advantage over more basic techniques such as comparisons in the data of 'before' and 'after' average effects as they allow a stronger statistical association to be obtained between the dependent variable (the market determinant) and the variables that will drive it (prices, number of airlines servicing a particular route, etc.).

A separate econometric model has been constructed for each of the market determinants described above because the set of statistical issues (completeness of data, model dynamics) will be specific to each determinant.[5]

The data used in this analysis contains monthly time series route data from January 2007 to December 2013, and includes 65 destinations served from Budapest (for a total of 130 inbound and outbound routes).[6]

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4 Quote from: Borenstein, S. and Rose, N. (2003) "The Impact of Bankruptcy on Airline Service Levels" AEA Papers and Proceedings, Competition policy in network industries.

5 A combined analysis of each of the three determinants would be highly complex and suitable data is not available

This data has been collected considering only information from passengers flying from origin to destination. Passengers taking connecting flights to other destinations or coming from long-haul non-direct flights are not included in the analysis. It is not possible to compare direct flight data with non-direct flight data, as separate fares are not paid for the different segments of a non-direct flight.

More details of the econometric techniques underpinning this analysis can be found in Section 3. The main benefits of the proposed econometric approach are that it can:

- Control for route-specific time invariant characteristics that are unobserved in the data.
- Control for potential circularity in the modelling, i.e. if capacity on routes adjusts in response to any changes in fares associated with Malév's bankruptcy. This means that the relationship between fares and capacity is 'circular'; capacity influences fares and vice versa. The effects of fares and capacity need to be isolated to avoid biased modelling results.

Our findings from the econometric modelling suggest that:

Impact on fares

- The key result of the econometric analysis suggests that the collapse of Malév is associated with an 8.0-8.6% decrease in average fares across all routes that Malév served prior to its bankruptcy.
- However, the true impacts of Malév's bankruptcy on average aviation fares may be smaller in magnitude, as the fares data used for this analysis does not include ancillary charges.

Impact on capacity

- Our preferred model suggests that the Malév bankruptcy is attributable to a 6.3% decline in average capacity.

6 The initial dataset contained data for 94 destinations (for a total of 188 inbound and outbound routes). After cleaning the dataset (such as removing routes with no data at all), the final number of destinations decreased to 65.

1. Introduction

1.1. Context

The airline industry operates in a cyclical environment. Periods of strong demand and narrow profit margins are routinely followed by equally long periods of weaker demand and economic instability – achieving sustainable profitability is an airline's common challenge.

Industry world-wide post-tax net profits are forecast to rise from USD 12.9 billion in 2013 to USD 18.7 billion in 2014, downgraded from International Air Transport Association's (IATA) previous forecast of USD 19.7 billion. Although this may appear to be a substantial profit, it is not particularly significant – for a USD 745 billion industry, it only represents an operating margin of 2.5%. In 2014, the airline industry's profit forecast equates to an average of USD 5.65 per departing passenger (up from USD 2.56 in 2012).

There are signs that may signify a cyclical downswing – overcapacity, labour looking for an increased share of industry profits and geopolitical events causing demand to slow could all generate a cumulative stress that guarantees only thin margins at best. This is forcing all carriers to achieve cost efficiencies and higher productivity if they are to compete, and capacity discipline (with overcapacity leading to revenue weakness) is a focus for all airlines.

European airline operating margins have underperformed other regions for a number of years.[7] With IATA's forecast for 2014 representing another year in which Europe is the least profitable major region for airlines, strategies for survival continue to be under focus. IATA figures show that the average margin for European carriers from 2009 to 2012 was just 0.3%; lower than for any other region and more than 2ppts below the global average of 2.4%.

European industry profit is amongst the world's weakest and well below the global average. IATA's forecast of a 1.9% EBIT margin in 2014 for Europe is below the world average of 4.3% by 2.4ppts. In contrast, for the US the EBIT margin is forecast to be 6.5% (reflecting structural improvements in this region). This is 2.2ppts above the world average, illustrating important regional disparities.

Within Europe, airlines from the CESE region are likely to be more severely challenged and will as a result continue to post substantial losses, although Czech Airlines, Air Baltic, Air Serbia and to some extent LOT, are expected to outperform others in the region.

Many of the carriers based in the CESE region are still carrying heavy losses from the past. A few have already been privatized, but unfortunately many privatization attempts have failed and the carriers now have to look for new perspectives.

With a number of airlines in the CESE region in financial distress, it is feasible that some may cease operations in the future. This report analyses the impacts of one such collapse, that of Hungarian airline Malév in February 2012, focussing on resultant changes in air services (carriers, routes, capacity and frequency), connectivity and airfares.

1.2. Scope

PwC was mandated by the European Commission to provide insight and "(…) a comprehensive analysis of the consequences of Malév's bankruptcy with a focus on the impacts in relation to air connectivity to/from Hungary and (when possible) on consumer welfare in the form of examining the basic parameters of airline competition

7 IATA

(prices, capacity, quality) by using econometric analysis of quantitative data. (…) information on the profitability of the airline over the years must be collected. This should include in particular the operations of the last two to three years before bankruptcy; to (…) possibly provide some insights to understand better the viability of the network airline operation model in the region, when operated on market based principles".

This paper, therefore, will provide background on a number of crucial aspects explaining the impact of Malév's bankruptcy. We will examine and evaluate the consequences of Malév's bankruptcy on: air connectivity to/from Hungary; Budapest Airport's business continuity and its role in Hungary; passenger experience; and consumer welfare. We will also look at the wider social impact caused by the airline's collapse.

1.3. Methodology

The information utilised in this report has been collected by means of interviews with local experts. Whenever possible, facts and opinions provided by local experts have been supported with analysis and desk research.

We have undertaken a thorough and robust quantitative analysis of the routes originally served by Malév to understand trends in both price (average fares) and capacity, the implication of Malév's collapse, and the likely correlations between the collapse and the current airline market in Hungary (and the underlying connectivity issue and impact on consumers).

While our main approach to the study was to both discuss directly with key stakeholders and to undertake substantial desk research as mentioned above, the analysis, and in particular the econometric analysis, utilised passenger itinerary and fare data from both the Milanamos and Sabre databases from which we extracted the following:

- passenger number by route and airline;
- ASK (Available Seat Kilometres) on a route and airline basis;
- the number of aircraft movements by route and airline;
- average fares per route and per airline;
- revenue generated per route on an airline basis; and
- load factors.

Sabre collects ticketing data through the GDS (global distribution system). The schedule data is provided by Innovata, a comprehensive source for airline schedule information. We are confident that the database is reliable enough to run the analysis and identify trends as per the scope of reference. We will however highlight the limit of the data in the econometric section (when this has limited the extent of analysis). Although the Sabre database is one of the most comprehensive airline data sources available, there are some limitations with the completeness of data:

- One particular limitation is the ability of the data to capture all transfer passengers. The information captures individual passenger ticketing itineraries and, therefore, if a passenger 'self-connects' on separately purchased tickets then this flight connection would not be captured.
- LCC fares are an estimate – as most of the tickets are bought via direct booking with the airline.

These limits will be more extensively explained in the econometric section of this Paper B.

1.3.1. Stakeholder interviews

We conducted interviews in Hungary to gain an understanding of the situation in Hungary pre- and post-Malév's bankruptcy. The parties interviewed are listed in Table 1 overleaf.

Table 1 – Stakeholders' interviews

Name	Role	Organisation	Topic
Mr. Gyula Győri	President	National Transport Authority	• Aviation industry/professional issues • Economic implications • Geopolitical effects
Mr. Kornél Szepessy	CEO	Hungarocontrol	• Impact on Air Traffic Control
Ms. Ildikó Szakmáry	Director of Aviation	Ministry of National Development	• Definition of connectivity • Changes in connectivity
Mr. Tamás Déri Mr. Barna Tarnóczy	CEO and co-owner MD	Tensi Tours Ltd.	• Effects on tourism
Mr. János Bagoly Mr Kam Jandu	Head of Commercial planning and strategy Chief Commercial Officer	Budapest Airport	• Effects on Budapest Airport • Evolution of spending trends of travellers by segment • Impact on the investment plans of Budapest Airport • Closing of Terminal 1 and related reactions of LC and FC carriers
Mr. József Váradi	CEO	Wizz Air	• Take up of slots following Malév's collapse • Market impact and competition effects
Mr Gergely Bartók	Chief lawyer	GE Lighting	• Impression of a major business travel client on the change in the aviation market after Malév's collapse • Company decisions affected by Malév's collapse
Mr. András Bognár	Aviation Advisor	SH&E	• Market impacts
Mr. Sándor Zákonyi	Former Cargo Director	Malév Cargo	• Cargo market change after the collapse of Malév • Impacts on cargo city project of Budapest Airport
Mr. György Cserfalvi	Co-owner and MD	Pannon Air Cargo	• Cargo market change after Malév's collapse • Corporates were mostly affected • Reaction of the market players
Mr. Tamás Pergel Mr. Martin Gauss	Former CFO Former CEO	Malév	• Corporate Malév structure • Malév's business network and suppliers • Effects on Budapest Ferenc Liszt International Airport • Employment data and information

1.4. Structure of the report

The remainder of the report is structured as follows:

- **Chapter 2** presents the economic and social consequences of the Malév bankruptcy.
- **Chapter 3** presents the econometric analysis.

2. Economic and social effects of Malév bankruptcy

2.1. Overview

Malév was declared bankrupt in February 2012 and all but 540 of Malév's 2,600 employees were laid off. This triggered further redundancies at Budapest Airport Ltd as well as at the company's suppliers. Trade unions have informed us that most of the former employees are still out of work.

These consequences point to the meaningful role Malév played in the Hungary economy and the possible effects Malév's failure may have had on both air service connectivity and quality in Hungary.

This section aims to determine the magnitude of the effects of Malév's collapse by providing a description of the economic and social impact that followed Malév's collapse.

2.2. Hungarian civil aviation sector

The aviation industry is a major direct generator of employment and economic activity – in airline and airport operations, aircraft maintenance, air traffic management, head offices and activities directly serving air passengers, such as check-in, baggage handling, on-site retail, cargo and catering facilities. Direct impacts also include the activities of civil aerospace manufacturers selling aircraft and components to airlines and related businesses.

Before Malév's collapse the aviation sector contributed HUF 236.2 billion (0.9%) to Hungarian GDP.[8] This total includes:

- HUF 108 billion or 47% directly contributed through the output of the aviation sector (airlines, airports and ground services).
- HUF 76.7 billion or 32% indirectly contributed through the aviation sector's supply chain.
- HUF 51.5 billion or 22% contributed through the spending by the employees of the aviation sector and its supply chain.

In addition there was a 'catalytic' benefit through tourism which raises the overall contribution to HUF 316.2 billion or 1.2% of GDP.

Aviation was an important and strong sector in Hungary, supporting the economy and providing a significant social benefit, especially in terms of job creation.

In terms of direct employment, before Malév's bankruptcy (i.e. 2011), the civil aviation industry[9] in Hungary accounted for 7,126 employees.[10] This includes air transport activity (i.e. Malév, Wizz Air and other smaller operators); service activities incidental to air transport (i.e. air traffic control, operation of terminal facilities and ground handling operations (excluding baggage handling)); and, repair and maintenance of aircraft (i.e. Aeroplex Central Europe, LH Technik and other smaller operators).

8 Oxford Economics, IATA 2009, PwC analysis

9 For the purpose of this analysis the civil aviation industry is defined as the aggregation of the following sectors: air transport; service activities incidental to air transport; and repair and maintenance of aircraft.

10 Eurostat

Before its bankruptcy, Malév directly employed circa 36% of workers in the Hungarian civil aviation industry.[11] Subsequent to Malév's bankruptcy, only a small number of aviation professionals managed to find similar positions in Hungary.

According to the Vice-President of the Hungarian Air Pilot Association (HUNALPA),[12] in 2012, only 20% of the 200 ex-Malév pilots managed to successfully sign a work contract with another airline. Pilots' employment prospects are likely to have been challenged by the fact that most of them were already over the age of 50 and many job opportunities often involved moving from Hungary to work in a different country.

The President of the Hungarian Air Cabin Crews Association (HUNACCA) reported that only 20 employees had managed to remain in the aviation sector in a cabin crew role.[13] Most of the former Malév employees were compelled to leave the civil aviation sector to look for work opportunities in a different country and/or sector – with specific (aviation) skills that are not often transferable to another industry.

In contrast, according to the former CFO of Malév,[14] 50% of the general administrative staff successfully managed to move to another position in a different sector such as other State owned companies in rail and public transport. But the over-supply of professionals generated by Malév's collapse led to lower wages. This trend was accentuated by the former Malév subsidiaries implementing quick measures to substantially reduce costs – wages were reported to be reduced by on average 15-20%. This particular consequence highlights the adverse and severe impact on former Malév employees (directly employed or not) with some of them being compelled to seek work outside Hungary.

The impact on net aviation sector employment can only be assessed by considering Malév job losses in conjunction with employment increases at the airlines that replaced Malév. This is not entirely straightforward, as the replacement airlines (primarily Wizz Air and Ryanair) operate on a multi-base, EU-wide basis – which may mean that increases in employee numbers are at different locations. Indicatively, Ryanair increased employee numbers by 7% or 621 staff between 2011 and 2012, and it is reasonable to assume that Wizz Air also increased staff during this period (although this data is not publicly available). A further complication is that many LCCs, notably Ryanair, employee a significant portion of their labour-force (especially pilots and cabin crew) as contracted labour rather than as permanent employees. The net impact on aviation sector employment in Hungary (and the wider region) cannot therefore be identified, but it is likely to be lower than the total job losses at Malév.

It is also notable that Malév dropped long-haul routes in 2008, followed later by American Airlines, Delta and Hainan. Thus there was already a substantial effect on levels of employment and on Budapest Airport, which saw its revenue drop significantly and transit traffic effectively disappear.

2.2.1. *Malév's Subsidiaries*

Malév had a number of subsidiaries which were impacted by the airline's collapse. The subsidiaries are as follows.[15]

Malév Ground Handling Ltd (MGH):

MGH was the largest handling service provider at Budapest Airport with about 700 staff and operating revenues close to EUR 35-40 million (or HUF 10 billion). About 50% of total revenues were generated by Malév. MGH also provided services to airlines that were part of the Oneworld alliance. Subsequent to Malév's collapse,

11 PwC calculation on Eurostat and Malév financial statements.

12 Máté Komiljovics, Job losses as Hungarian airline collapses, EIRO 2012.

13 Ibidem.

14 Mr Tamás Pergel, former CFO of Malév airlines and as such, a member of the management of the airline during cessation of operations.

15 The information and data on Malév subsidiaries reported in this section have been provided by Mr Tamás Pergel, former CFO of Malév airlines and as such a member of the management of the airline during cessation of operations.

MGH initiated a massive redundancy programme, cutting about 250 jobs. MGH shares had to be sold to Hungarian State Holding Ltd. to ensure the business's continued operation. In 2012, Wizz Air issued a request for proposal and MGH was successfully mandated. This provided MGH with stability and regular revenue, although the scope of services requested by the low cost carrier was more limited compared to Malév's (leading to lower income).

Aeroplex Central Europe Ltd. (ACE):

A high percentage of ACE's operations were also related to Malév activity. ACE, a maintenance provider, was not profitable before Malév's collapse, and its financial situation deteriorated further afterwards. The Government purchased the company's shares and injected further equity into the business but, despite this support, the company's performance did not improve. ACE has not been able to build a strong client base; rather it is performing ad hoc base maintenance activities, which makes it difficult to generate sufficient revenue to restore ACE's financial heath and business. The utilisation of ACE's hanger is also very low and is mainly confined to winter peak season. However, possibly due to the social implications that a cessation of ACE's operations could have, the Hungarian State continues to support the company, with business continuity considered to be in the national interest.

Malév Air Tours (MAT):

MAT is a profitable medium-sized travel agency, active in both the inbound and outbound market. Management significantly reduced staff numbers and downsized its operation after Malév's collapse. It has been privatised and transformed to a mainly inbound service provider in a niche market: patients from abroad travelling to Budapest for dental services.

The effects of the Malév's bankruptcy on the tourism industry are further analysed in section 2.8.

Pannon Air Cargo (PAC):

PAC is a customs and local cargo service provider which was in close partnership with Malév's cargo operations. Subsequent to Malév's collapse the company was privatised because of its important and specific role; it has remained in service following a moderate downsizing of its operation.

The effects of Malév's bankruptcy on air cargo services are further analysed in section 2.4

Air Budapest Club (ABC):

ABC is a small labour sourcing company. This subsidiary used to outsource flight attendants to Malév, but due to legislation changes it was not possible for affiliated companies to provide this service any longer. This led to substantial organisational downsizing.

2.2.2. Malév's Supply Chain

Malév's collapse generated severe supply chain disruption, with several medium-sized suppliers, such as BAS Kft (catering), that were strongly or fully dependent on Malév's business shutting down operations.

The following companies – part of the aviation supply chain – were significantly affected by Malév collapse:[16]

Budapest Airport:

The effects of Malév's bankruptcy on Budapest Airport are separately analysed in section 2.3.

Leasing companies:

The collapse has had important repercussion on both aircraft lessors and banks due to unpaid lease rentals and aircraft value losses, combined with the difficulty in finding alternative lessee or buyers in an acceptable period

16 The information and data on Malév's supply chain reported in this section have been provided by Mr Tamás Pergel, former CFO of Malév airlines and as such a member of the management of the airline during cessation of operations.

of time to avoid further incremental loss while aircraft are on the ground. Malév had been leasing 17 Boeing NGs from ILFC, one Boeing NG from Macquarie and 4 Q400s from SAS.

Other suppliers:

Trenkwalder – a personnel service provider – provided Malév with flight attendants to optimize cost. The operating margin was already quite narrow before Malév's collapse, and its financial health became critical post Malév with severance payments being due.

Fuel suppliers and Hungarocontrol (Air Navigation Services Provider, ANSP) were similarly affected at Budapest Airport (as well as other medium-sized suppliers). Many of the latter were strongly or fully dependent on Malév's operations. A lot of these small companies ceased operations following Malév's collapse.

2.2.3. Malév's partners

Ticket sales were completed mainly via the BSP[17] network operated by IATA. Malév also had a network of general sales agents (GSAs). The former CFO of Malév indicated that direct sales were not significant except for internet sales, which represented 10-15% of revenue.[18]

The BSP system had a central role when Malév collapsed as it enabled a smooth reimbursement of passengers (although not all of them). This will be further expanded in the report.

2.3. Budapest Liszt Ferenc International Airport

Budapest Airport (BUD) was privatised in 2005 with the ambition of growing into a major CEE hub. However the Malév collapse completely transformed the market dynamics. As a result, the airport management was forced to react quickly with substantial layoffs (approximately 300 people lost their job). According to airport representatives,[19] Budapest Airport did not implement targeted discounts to attract airlines subsequent to the collapse, but instead incentives were available such as a route recovery incentive.

The attractive incentives package[20] offered by Budapest Airport has been vital in aiding its recovery. Under the scheme, which was introduced several years prior to the Malév collapse, airlines launching new routes could benefit from reduced landing fees for up to five years. For new long-haul services, there is a 100% reduction in years one and two, a 75% reduction in year three, a 50% reduction in year four, and a 25% reduction in year five. For new short haul services, the discount in year one is 100%, year two - 75%, year three - 50%, year four - 25%, and year five - 10%. There is, additionally, a two-year route recovery incentive for airlines starting routes recently terminated by others. The discount in year one is 75% and in year two is 50%.

The full extent of the collapse of Hungary's national carrier has been revealed by Budapest Airport.[21]

2.3.1. Air traffic decline and recovery

Malév carried around 3.3 million passengers at Budapest Airport per annum prior to its collapse, around 36% of the airport's total passenger movements. From 8.9 million passengers in 2011, the total number of passengers at Budapest Airport slumped to the equivalent of 5.7 million annual passengers in the months following the collapse. The airport had prepared a detailed action plan and scenario for each individual route to attract alternative airlines immediately. For example, Air Berlin agreed to serve the route to Berlin and Lufthansa agreed to serve the routes to Hamburg and Berlin. Many other airlines similarly introduced new connections or increased existing frequencies and capacity. With the intensive efforts made by the airport and

17 Billing and Settlement Plan (BSP) is a system allowing for selling, reporting and remitting procedures of IATA sales agents, as well as providing financial control and cash flow services to affiliated airlines.

18 Mr Tamás Pergel, former CFO of Malév airlines and as such, a member of the management of the airline during cessation of operations.

19 The information and data presented in this section have been provided by Mr. János Bagoly, Head of Commercial planning and strategy at Budapest Airport.

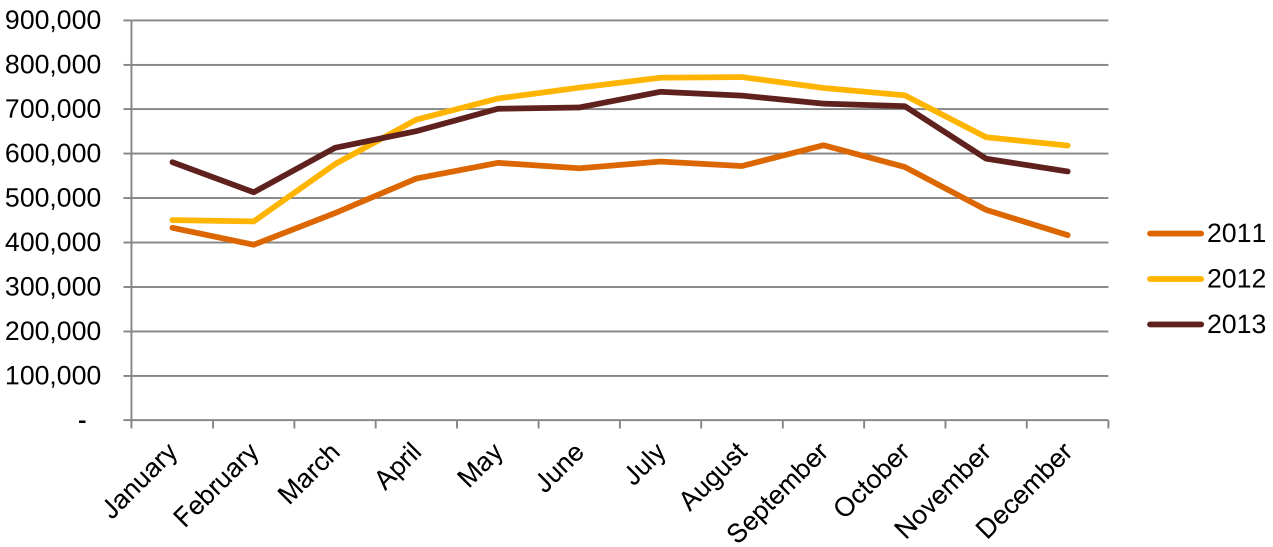
20 Airport business Magazine, October 2012

21 Mr. János Bagoly, Head of Commercial planning and strategy at Budapest Airport.

without any financial support from the State, the airport recovered rapidly. Total passenger volumes fell by much less than initially expected, with total 2012 volumes of 8.5 million passengers (only 400,000 passengers lower than the previous year).

The mix of traffic, however, changed substantially. The departure of Malév left the airport with almost no transfer traffic (around 20% of traffic prior to Malév 's collapse) as there was no longer a network carrier based at the airport and much of the capacity gap left by Malév was replaced by LCC point to point services. This indicates that point-to-point traffic in fact increased following Malév's exit. It is worth noting that arriving and departing passengers create greater value for airports than transfer passengers, as the latter group are frequently exempt from charges and spend little in shops. They are, conversely, important to network carriers' ability to obtain economies of density.

Figure 1 – Monthly Origin-Destination passengers at Budapest airport, 2011-2013



Source: Milanamos Planet Optim Future.

The new dominant carriers at Budapest (Wizz Air and Ryanair) opened many 'new' destinations, while other EU network carriers either increased flight frequencies or increased aircraft capacity on their existing flights (through revised seat configurations).

Wizz Air obtained several of the former bilateral traffic rights that Malév previously held, allowing them to operate services to Russia, Ukraine, and Turkey. Moreover, Wizz Air opened new routes to the east, starting direct flights to Dubai (UAE), Baku (Azerbaijan) and Kutaisi (Georgia).

There are some regions which are much less accessible following the loss of Malév. The first of these is the Balkan-peninsula, for example Skopje, Sarajevo, Tirana, Podgorica, Sofia, and Ljubljana. Belgrade had also been one of the cities lacking connectivity with Budapest, but Air Serbia's new daily flight has resolved this. The second is the Near-East (Damascus, Amman and Beirut), although the unstable political situation in the region raises questions over the profitability of these routes.

The third and perhaps most important issue is the lack of long-haul passenger flights. Budapest was aiming to become an international hub and until 2012 there were direct flights to Beijing (operated by Hainan Airlines, code-shared by Malév) and New York (seasonally operated by American Airlines, code-shared by Malév). Prior to 2012, Malév operated its own flights to New York, Toronto and Bangkok, and Delta also had a seasonal connection to New York.

The Budapest-Doha flight operated by Qatar Airways performs well (although with a flight time of five hours, the route is shorter than a typical long-haul flight), using the larger capacity A321 as a replacement for the A320 originally used. Having operated a number of direct flights from Dubai to Vienna, Prague, Warsaw and Kiev, Emirates recently commenced a route to Budapest (complimenting Emirates' new customer service centre at the airport). However, it seems unlikely that Etihad would open a Budapest-Abu Dhabi flight, because of their investment in Air Serbia and the direct flights already operated to Belgrade.

In the current situation, attracting long-haul flights to Budapest appears difficult. Good airport marketing and governmental support can help, but these are unlikely to be enough. A flight based (just) on a governmental decision is rarely successful and profitable, and without connection possibilities and feeder flights it is not easy to fill a wide-body aircraft. Low-cost airlines usually do not provide transfer possibilities, so the opportunity for new long-haul connections appears relatively low.

Overall, Budapest Airport currently appears to be in a much more commercially robust situation, with the airport relying on several medium-sized, solvent carriers rather than one dominant airline with continual payment issues.

2.3.2. Property rentals and developments

The property rental business suffered substantial loss. Indeed, Malév's initial plan was to move its headquarters to the airport building, which in anticipation was being partially refurbished at substantial cost. However the building has remained vacant. And with more than 50% of Budapest Airport's property income being derived from Malév activity, the airport was severely impacted by Malév's collapse.[22]

In terms of expansion-related projects, the following infrastructure improvements were also suspended by Budapest Airport after Malév's collapse:

- Two new piers for Terminal 2A and 2B.
- A new cargo area ('Cargo City project').

Both projects intended to support the airport's expansion strategy developed in light of the expected increase in future traffic demand growth. While the new piers were originally designed to facilitate the new gates opening, the Cargo City project was intended to equip the airport with a modern cargo facility aligned with the best standards of the major CEE hubs (see section 2.4).

A further effect of Malév's bankruptcy concerned the closure of Budapest Airport Terminal 1. Airport representatives[23] reported that following the collapse of the Hungarian national carrier, low-cost passengers increased from 3.5 to around 4.0 million per year. As Terminal 1 capacity was inadequate to serve the growing passenger flow, the airport was compelled to close down the facility and transfer both low-cost and network carriers to Terminal 2. The decision had significant price implication for airlines and as result for the airport's revenue.

Budapest Airport 'SkyCourt', the shopping mall constructed between Terminal 2A and 2B, however strongly benefited from the closure of Terminal 1. Indeed the relocation of low-cost passengers to Terminal 2 resulted in an increase in traffic flow from 5.5-6 million to 8 million passengers per year, with significant economic benefits for the facility.

2.4. Air cargo market in Hungary

This section provides a description of the current status of the air cargo market in Hungary.

22 Mr János Bagoly, Head of Commercial planning and strategy at Budapest Airport.

23 The information and data presented in this section have been provided by Mr. János Bagoly, Head of Commercial planning and strategy at Budapest Airport.

As reported by the co-owner and Managing Director of Pannon Air Cargo[24] Malév was the dominant player in the Hungarian market, with approximately 30% of the Hungarian cargo market. Following its collapse a large share of the cargo market activity was not replaced by other airlines in Hungary. Indeed, the low cost carriers that replaced Malév on the most attractive routes – Wizz Air and Ryanair – do not provide any cargo service. As a result, network carriers operating in the country up-gauged their aircraft allowing for a small amount of additional cargo capacity while further market share was gained by integrated service providers such as TNT and DHL.

This trend was accentuated by the withdrawal of long-haul operations from Budapest Airport by US carriers (American and Delta), which originally started to operate these routes soon after Malév's decision to focus on short-haul routes and discontinue long-haul operations. Likewise Hainan Airlines, which was flying to Beijing and beyond in China, decided to leave the market due to the lack of a local feeder airline.

The air cargo market was significantly affected by the reduction in direct long-haul services. This was because air cargo is time sensitive and requires a limited number of transhipments to avoid damaging the goods. The majority of goods that are delivered by air carriers to and from Hungary are mainly high tech components and products. Key industries and sectors in the region include:

- Technology sector: Nokia, Ericsson, Flextronics, Samsung.
- GE holding: Energy (turbines); Aviation (turbines) and Lighting (LEDs).
- Pharmaceutical: Ceva Phylaxia; Procter&Gamble.
- Heavy industry (control panels): Suzuki, Danfoss.

As a result of the change in cargo supply, there was a shift in the demand with most of the companies transiting their goods via the main European hubs. Goods are then delivered to Hungary by road without to the need to utilise short haul air operators to connect to Budapest Airport. A few resilient short-haul network carriers in the Budapest market do provide air cargo service and now have a dominant position, resulting in air cargo tariffs increasing by 30-40% on average.

Hungarian road cargo operators benefit only partially from the demand generated by the tightening air cargo supply, as a large part of the road transport services are also provided by competitors at the main hub airports. Currently, the main airports for Hungarian cargo are Vienna (VIE), Munich (MUC) and Amsterdam (AMS).

Hence, Budapest Airport postponed its 'Cargo City' project. The project was aimed at modernising the outdated cargo infrastructure and facilities in order to keep pace and compete with developed cargo bases, mainly located in Vienna (VIE) and Prague (PRG) airports.[25] The plan had little chance to progress without the support of an airport functioning as a regional hub, involving long-haul operations, both of which are conditions currently missing at Budapest Airport.

Budapest Airport's prospect of developing as a hub vanished with Malév's collapse and most of the companies in the aviation sector restructured their business. Hence, the vulnerable cargo handling services at Budapest Airport was severely hit.

2.5. Airline route analysis

This section seeks to assess the strategies adopted by other airlines following the bankruptcy of the Hungarian national carrier.

24 Mr György Cserfalvi, Co-owner and Managing Director of Pannon Air Cargo.

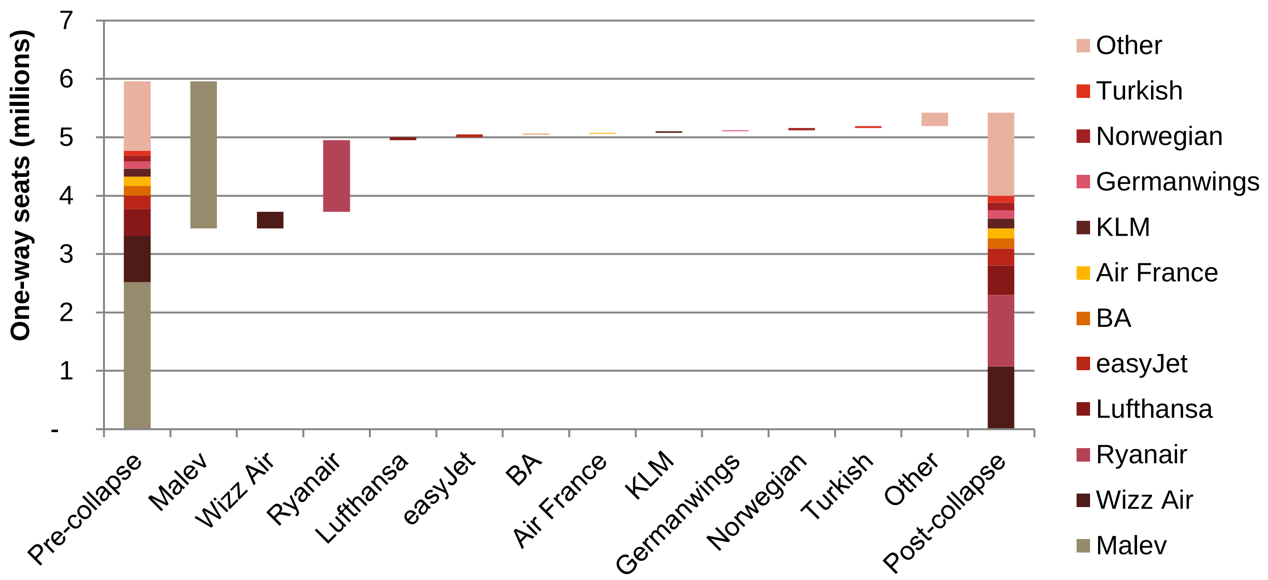
25 Mr János Bagoly, Head of Commercial planning and strategy at Budapest Airport

2.5.1. Overview

The Hungarian air travel market has recovered following the loss of national carrier Malév Hungarian Airlines, particularly in terms of available airline seat capacity. In the days and weeks that followed, up to 80% of the point-to-point traffic lost from Malév's collapse was quickly recovered. By the start of the 2012 summer season nearly all of the point-to-point traffic was already recovered. Wizz Air and Ryanair were first to fill the void, however other carriers from across Europe also increased their presence in the months following Malév's collapse. LCCs now make up a substantial proportion of seat capacity at Budapest airport (58% in the 12 months following Malév's collapse compared with 25% in the 12 months prior to the collapse).[26]

Malév offered approximately 2.5 million seats from Budapest airport (one-way) in the 12 months leading to its collapse, giving it a 42% share of total capacity. Ryanair, which has quickly become the largest carrier in Budapest, filled approximately half of the void left by Malév, adding around 1.2 million seats from Budapest Airport in the 12 months following Malév's collapse. Wizz Air added around 300,000 seats in the same period. Post-collapse, total capacity at Budapest was 9% below pre-collapse levels. However, from purely a point-to-point perspective, capacity has fully recovered as a significant portion of Malév's traffic was transfer.

Figure 2– Available annual seats capacity from BUD by airline prior to and following the Malév collapse



Note: One-way scheduled seat capacity offered from Budapest Airport. Pre-collapse covers March 2011 to February 2012 and post-collapse covers March 2012 to February 2013.

Source: *Milanamos Planet Optim Future, PwC analysis*

Until a true hub carrier is based at the airport, Budapest Airport will have to rely on point-to-point traffic, particularly from Wizz Air and Ryanair. Without the transfer component being replaced, Budapest traffic levels are unlikely to fully recover. But from purely a point-to-point perspective, traffic at Budapest is already above pre-Malév grounding levels.

Whilst other airlines, particularly the LCCs Ryanair and Wizz Air, have managed to fill much of the gap left by Malév's collapse, Hungary is still without a true network carrier. In order to examine the shift that occurred in the market, the analysis that follows focuses on specific routes, originally operated from Budapest International

26 Based on Milanamos PlanetOptim Future data.

Airport by Malév on a regular basis in the two years before its bankruptcy. Of all the destinations served by the airline, only 28 routes were operated on a year-round and continuous basis for the two years prior to its bankruptcy.[27] These 28 routes were considered in the analysis.

Table 2 shows the pre- and post- Malév collapse levels of seat capacity and frequency for each of the 28 routes. Overall seat capacity and frequency decreased by 8% and 22% respectively. At a more detailed level, seat capacity decreased on 21 out of 28 routes. The remaining seven routes (Amsterdam, Berlin, Brussels, Hamburg, London, Rome and Warsaw), had seat capacity increases (29% on average). In the case of Berlin and Brussels, the frequency also increased (12% and 14% respectively) whilst for London and Rome it remained almost unchanged (up 1%). The remaining 24 routes showed a decrease in flight frequency, on average, by 30%.

Table 2 – Average monthly seat capacity and frequency provided by regional, low-cost and network flag carriers (including Malév) before and after the collapse (period of reference: 23 months before/after the bankruptcy)

Route	Seat capacity (Pre)	Seat capacity (Post)	Seat capacity change (%)	Frequency (Pre)	Frequency (Post)	Frequency change (%)
Amsterdam	142,374	209,080	+47%	355	339	-4%
Berlin	41,429	65,840	+59%	160	179	+12%
Brussels	110,327	153,040	+39%	282	322	+14%
Bucharest	54,405	15,633	-71%	256	139	-46%
Copenhagen	87,292	43,588	-50%	178	105	-41%
Dublin	44,144	36,192	-18%	119	99	-16%
Frankfurt	171,463	112,808	-34%	424	303	-28%
Gothenburg	26,302	17,969	-32%	90	50	-45%
Hamburg	11,394	15,677	+38%	96	80	-17%
Helsinki	74,217	54,082	-27%	172	128	-26%
Istanbul	46,448	27,808	-40%	131	128	-2%
Kiev	22,097	9,395	-57%	130	73	-44%
London	453,503	501,149	+11%	586	594	+1%
Madrid	37,035	28,208	-24%	117	75	-36%
Milan	83,520	62,631	-25%	211	167	-21%
Moscow	37,342	22,393	-40%	145	130	-10%
Stockholm	73,619	60,479	-18%	151	111	-27%
Paris	166,920	150,832	-10%	377	280	-26%
Prague	60,275	25,254	-58%	292	175	-40%
Rome	84,267	104,552	+24%	183	185	+1%

27 Note that in this analysis, routes are considered at a city level rather than an airport level.

Route	Seat capacity (Pre)	Seat capacity (Post)	Seat capacity change (%)	Frequency (Pre)	Frequency (Post)	Frequency change (%)
Sofia	9,759	2,532	-74%	93	16	-83%
Stuttgart	37,771	13,982	-63%	145	94	-35%
Tel Aviv	43,516	22,570	-48%	144	83	-43%
Thessaloniki	9,057	5,305	-41%	73	21	-71%
Tirgu Mures	17,948	5,368	-70%	71	25	-65%
Varna	5,203	923	-82%	59	4	-93%
Warsaw	40,771	88,612	+117%	225	215	-5%
Zurich	79,357	49,425	-38%	248	185	-25%
Average	-	-	-8%	-	-	-22%

Source: Elaboration on Sabre ADI data (2014)

2.5.2. Low Cost Carriers

We closely examine Wizz Air and Ryanair, the two airlines that replaced the majority of the gap left by Malév's exit. Details are shown in

Table 3 and Table 4.

Wizz Air

Wizz Air replaced Malév on eight routes after its collapse, albeit with a lower frequency (the average flight frequency on these 8 routes decreasing from 95 to 16 per month). In contrast, the average seat capacity per flight increased on average by 56% (from 115 to 180 seats). This is directly related to the type of aircraft/seat configuration operated by Wizz Air. Malév's fleet mainly consisted of Boeing 737-600 and 737-700 which ranges in size from 109 to 120 seats; in contract, Wizz Air operates an all-Airbus A320 fleet with a seat capacity of 180.

The profitability of routes across Malév's network varied substantially, with loss making routes (such as Bucharest and Sofia) being discontinued following an original take-up by Wizz Air following Malév's exit.

Wizz Air was able to increase its frequency on 11 of the 13 existing routes with average flight frequency increasing by 22%. The remaining two routes (Helsinki and Tirgu Mures) experienced a decrease in flight frequency by 49% and 9% respectively. In absolute terms, the flight frequency was often halved when compared to the period in which Malév was still operating.

Table 3 – Average monthly seat capacity and frequency offered by Malév (before its bankruptcy) and Wizz Air (period of reference: 23 months before/after the bankruptcy)

Destination city	New or existing route for Wizz Air after MA collapse	Frequency (Malév)	Frequency (Wizz Air - Pre MA collapse)	Combined frequency (Pre MA collapse)	Frequency (Wizz Air - Post MA collapse)	Frequency change – Wizz Air only (%)	Frequency change - Total (%)
Bucharest	New route	204	-	204	9	-	-96%
Kiev	New route	60	-	60	29	-	-52%
Moscow	New route	71	-	71	8	-	-89%
Sofia	New route	93	-	93	8	-	-91%
Tel Aviv	New route	94	-	94	27	-	-71%
Thessaloniki	New route	73	-	73	8	-	-89%
Varna	New route	59	-	59	4	-	-93%
Warsaw	New route	108	-	108	32	-	-70%
Average (1)		**95**	**-**	**95**	**16**	**-**	**-83%**
Amsterdam	Existing route	161	78	239	97	+25%	-59%
Brussels	Existing route	116	70	186	90	+29%	-52%
Copenhagen	Existing route	117	38	155	47	+23%	-70%
Frankfurt	Existing route	117	15	132	21	+43%	-84%
Gothenburg	Existing route	67	23	90	25	+13%	-72%
Helsinki	Existing route	92	15	107	8	- 49%	-93%
Istanbul	Existing route	54	8	62	9	+9%	-85%
London	Existing route	115	163	278	177	+9%	-36%
Madrid	Existing route	88	29	117	38	+29%	-68%
Milan	Existing route	105	41	146	92	+122%	-37%
Stockholm	Existing route	105	24	129	32	+35%	-75%
Rome	Existing route	75	53	128	60	+14%	-53%
Tirgu Mures	Existing route	46	25	71	23	- 9%	-68%
Average (2)		**97**	**45**	**142**	**55**	**+22%**	**-61%**
Total Frequency		***2,020***	***582***	***2,602***	***844***		***-68%***

(1) Average of the 8 routes previously offered by Malév
(2) Average of the 13 existing routes offered by Wizz Air
Source: Sabre ADI data (2014), PwC analysis

It is worth noting that the airport served by Malév and Wizz Air on some routes differ. Wizz Air typically serves secondary airports that are further from the city centre, making them less convenient, particularly for business travellers. For example:

City	Airports Served by Malév	Airports Served by Wizz Air
Amsterdam	AMS	EIN
Brussels	BRU	CRL
Copenhagen	CPH	MMX
Frankfurt	FRA	HHN
Istanbul	IST	SAW
London	LGW	LTN
Milan	MXP	MXP, BGY
Stockholm	ARN	NYO
Helsinki	HEL	TKU
Kiev	KBP	IEV
Warsaw	WAW	WMI, WAW

Source: Milanamos Planet Optim Future.

Ryanair

Ryanair started operating 13 routes previously operated by Malév, with three of these being served for a short period of time only. In two cases (Frankfurt and Thessaloniki), Ryanair left the routes to Wizz Air, while in the third case (Hamburg), Ryanair abandoned the route for unknown reasons. As in the case of Wizz Air, the flight frequency is shown to be, on average, almost half that compared to the period in which Malév was in operation.

After Malév's bankruptcy, Ryanair was able to increase its flight frequency significantly (almost 300%) on the only route which was operated already in competition with Malév (Dublin). The average seat capacity per flight increased by 56% as Ryanair operates an all-Boeing 737-800 fleet with 189 seats per aircraft, compared to the 124 average seats provided by Malév. The pattern here is therefore similar to the one observed for Wizz Air.

Table 4 – Average monthly seat capacity and frequency offered by Malév (before its bankruptcy) and Ryanair (period of reference: 23 months before/after the bankruptcy)

Destination city	New or existing route for Ryanair after MA collapse	Frequency (Malév)	Frequency (Ryanair – Pre MA collapse)	Combined frequency (Pre MA collapse)	Frequency (Ryanair - Post MA collapse)	Frequency change – Ryanair only (%)	Frequency change - Total (%)
Amsterdam	New route	161	-	161	28	-	-83%
Brussels	New route	116	-	116	93	-	-20%
Frankfurt	New route	117	-	117	3	-	-97%
Gothenburg	New route	67	-	67	22	-	-67%
Hamburg	New route	96	-	96	9	-	-91%
London	New route	115	-	115	134	-	+17%
Madrid	New route	88	-	88	36	-	-59%

Milan	New route	105	-	105	71	-	-32%
Stockholm	New route	105	-	105	33	-	-69%
Paris	New route	147	-	147	47	-	-68%
Rome	New route	75	-	75	58	-	-23%
Thessaloniki	New route	73	-	73	11	-	-85%
Warsaw	New route	108	-	108	30	-	-72%
Dublin	Existing route	54	12	66	48	+300%	-27%
Total Frequency				***1,439***	***623***		***-57%***

Source: Sabre ADI data (2014), PwC analysis

As far as airline strategy is concerned, Ryanair has been characterised by a robust competitive approach as it replaced Malév on 13 routes immediately after its bankruptcy. In most of the cases (9 out of 13) these routes were also served by Wizz Air, with whom Ryanair entered in direct competition. Wizz Air, on the other hand, adopted a more conservative strategy by opening eight new routes after the bankruptcy, six of which were not previously operated by Ryanair.

Like Wizz Air, Ryanair tends to operate from secondary airports and many of the routes replaced by Ryanair are operated from a different airport compared with Malév.

For example:

City	Airports Served by Malév	Airports Served by Ryanair
Amsterdam	AMS	EIN
Brussels	BRU	CRL
Frankfurt	FRA	HHN
Hamburg	HAM	LBC
London	LGW	STN
Milan	MXP	MXP, BGY
Paris	CDG	BVA
Rome	FCO	CIA
Stockholm	ARN	NYO
Warsaw	WAW	WMI, WAW

Source: Milanamos Planet Optim Future.

The substitution of Malév by Wizz Air and Ryanair on the identified routes to/from Budapest Airport had important consequences in terms of the service offered to passengers. In the majority of routes, the service provided by Malév, characterised by frequent – often daily – flights to primary airports was replaced by services with reduced frequency to a larger proportion of secondary airports. So while much of the available seat capacity on routes formerly offered by Malév has been replaced, the quality of the connection in terms of the level of frequency and the location of the airport relative to the city centre has diminished. This impacts consumers, particularly business passengers, in terms of level of connectivity.

It is understood that Malév provided higher frequency services with lower capacity aircraft and lower load factors compared with the carriers (particularly Wizz Air and Ryanair) that have replaced it. Malév's unit costs were higher as a result of this, making it challenging to achieve route profitability. If Malév was still present in the market, it is likely that it would have undergone restructuring which may have resulted in: i) a reduction in capacity; and ii) a reduction in frequencies to boost load factors and generate sufficient revenues to cover operating costs.

Therefore, it is important to bear in mind that any airline can only sustain services that are commercially viable.

2.5.3. Network carriers

Table 5 shows the change in the service offered in terms of seat capacity and frequency by network carriers in the period before and after the Malév collapse. The analysis considers the 28 routes on which Malév operated continuously in the two years before its bankruptcy. The 'pre' and 'post' monthly averages are calculated respectively on the 23 months before the Malév collapse and on the 23 months after the Malév collapse.

Table 5 – Average monthly seat capacity and frequency offered by network carriers including Malév before and after bankruptcy Malév

Route	Seat capacity Pre (Network carriers including Malév)	Seat capacity Post (Network carriers including Malév)	Seat capacity change (%)	Frequency Pre (Network carriers including Malév)	Frequency Post (Network carriers including Malév)	Frequency change (%)
Amsterdam	35,901	30,440	-15%	278	195	-30%
Berlin	11,087	1,399	-87%	107	10	-90%
Brussels	22,734	14,705	-35%	212	135	-36%
Bucharest	25,594	6,134	-76%	256	124	-52%
Copenhagen	16,745	1,791	-89%	117	13	-89%
Dublin	15,821	8,899	-44%	107	50	-53%
Frankfurt	55,006	45,388	-17%	409	275	-33%
Gothenburg	7,577	-	-100%	67	-	-100%
Hamburg	11,394	-	-100%	96	-	-100%
Helsinki	21,626	13,619	-37%	157	93	-41%
Istanbul	18,619	19,155	3%	123	118	-4%
Kiev	7,302	-	-100%	60	-	-100%
London	45,213	29,214	-35%	309	181	-41%
Madrid	11,968	-	-100%	88	-	-100%
Milan	20,725	-	-100%	169	-	-100%
Moscow	18,637	15,880	-15%	145	119	-17%
Stockholm	13,850	-	-100%	105	-	-100%
Paris	44,192	27,782	-37%	321	173	-46%
Prague	32,417	23,254	-28%	292	171	-41%

Route	Seat capacity Pre (Network carriers including Malév)	Seat capacity Post (Network carriers including Malév)	Seat capacity change (%)	Frequency Pre (Network carriers including Malév)	Frequency Post (Network carriers including Malév)	Frequency change (%)
Rome	17,623	11,299	-36%	130	63	-51%
Sofia	9,759	532	-95%	93	5	-95%
Stuttgart	6,573	-	-100%	85	-	-100%
Tel Aviv	21,249	7,633	-64%	144	53	-63%
Thessaloniki	9,057	-	-100%	73	-	-100%
Tirgu Mures	3,320	60	-98%	46	1	-99%
Varna	5,203	16	-100%	59	0	-100%
Warsaw	19,232	11,443	-40%	225	149	-34%
Zurich	11,398	15,657	37%	121	116	-4%
Average	**-**	**-**	**-47%**	**-**	**-**	**-53%**

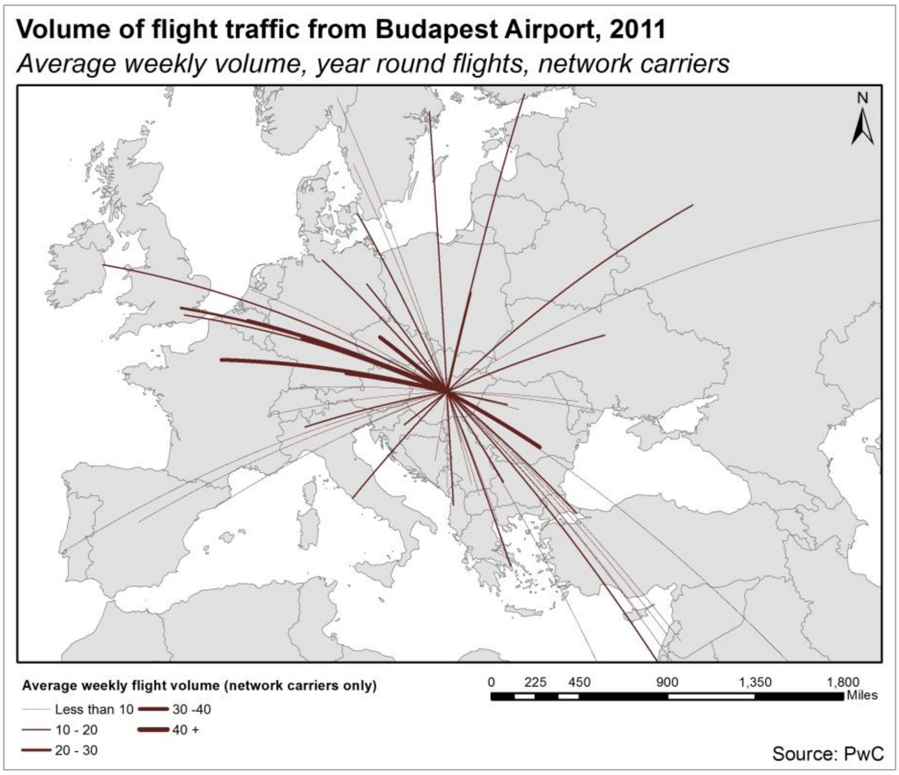
Source: Sabre ADI data (2014), PwC analysis

As a result of Malév's bankruptcy, the seat capacity offered on network carriers declined on average by 47%. At a more detailed level of analysis, eight routes were not operated by any network carrier after the bankruptcy, while 17 presented a reduction in the seat capacity offered with the exception of Istanbul (+3%) and Zurich (+37%).

In terms of flight frequency by network carriers, the situation has significantly worsened: all of the 28 routes considered presented a lower frequency of service in the period after bankruptcy. Overall, the number of monthly frequencies offered by network carriers on the 28 routes formerly operated by Malév has more than halved (declining by 53%) following the collapse of Malév.

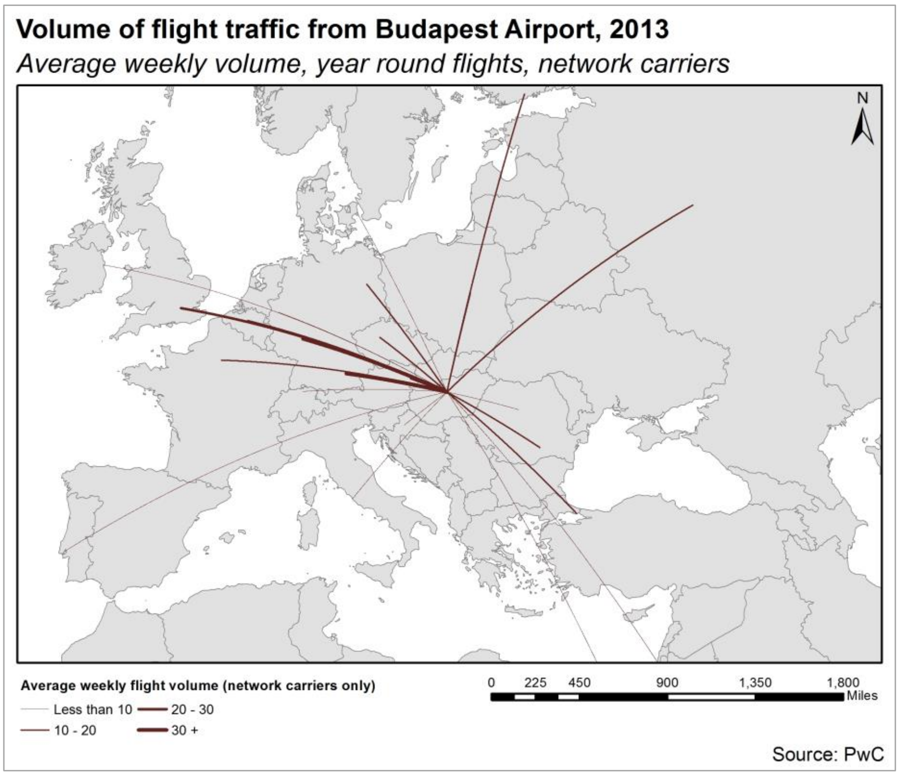
The decrease in network flight frequency can be further illustrated by comparing the volume of network carriers' flight traffic (one-way average weekly frequency) from Budapest Airport in 2011 (Figure 3) with the volume of traffic in 2013 (Figure 4).

Figure 3 – Volume of flight traffic from Budapest Airport (2011)



Source: Sabre ADI data (2014), PwC analysis

Figure 4 – Volume of flight traffic from Budapest Airport (2013)



Source: Sabre ADI data (2014), PwC analysis

2.6. Time sensitive passengers

Time sensitive passengers, such as those travelling for business purposes, are concerned with reaching their destination in the shortest possible time and at times which suit their purpose of travel. Their flexibility is not extensive in terms of time of departure or arrival, and they would need the option to change their reservations at short notice.[28] Time sensitive passengers are often prepared to book a more expensive ticket to secure flexible ticket options.[29]

The overall analysis suggests that time-sensitive passengers have been significantly impacted by Malév's bankruptcy. Several routes are no longer operated by network carriers and those which are still in operation present a reduction on the monthly frequency. Although LCCs have replaced much of the capacity lost, many of these routes serve secondary airports in the destination city, which are often located further from the city centre making it less convenient for business travellers.

Further analysis was conducted on airline schedules to assess how many destinations could be reached for a business meeting in a day trip to or from Budapest before and after the Malév bankruptcy.

A sample weekday (Monday) was taken for the summer (August) and winter (February) schedules in both 2011 and 2013 to assess the impact on a seasonal basis. The analysis was conducted across all carriers (including LCCs) as well as for legacy carriers only. The criteria to assess the number of feasible routes[30] were as follows:

- A return service would arrive and depart on the same day; and
- A passenger would have at least 4 hours at the destination during business hours of 09:00-18:00.

The number of feasible day trip destinations to Budapest for the summer schedules saw the largest decline, with the impact being less pronounced for day trips from Budapest. The winter schedules also saw a decline. As business travellers tend to travel more with network carriers, we have also conducted the same analysis excluding LCCs. Given the increase in market share of LCCs following the collapse of Malév, the number of feasible day trips by network carriers has declined significantly. The feasible destinations for day trips are summarised in Table 6.

Table 6 – Feasible day trips to and from Budapest for 2011 and 2013

	Direction	Summer 2011	Summer 2013	Winter 2011	Winter 2013
All carriers	To Budapest	39	23	29	22
	From Budapest	27	20	22	14
Network carriers	To Budapest	36	16	33	15
	From Budapest	22	13	23	14

Source: Sabre ADI data (2014), PwC analysis

These findings are further supported by opinions expressed by General Electric which are summarised in the text box below.

28 CAA, An economic assessment of the impacts of granting fifth-freedom rights to passenger services from UK regional airports, Annex A – The definition of aviation markets.

29 Michael GREMMINGER, Directorate-General Competition, unit D-2, The Commission's approach towards global airline alliances — some evolving assessment principles – Competition Policy Newsletter , spring 2003. Available at: http://ec.europa.eu/competition/publications/cpn/2003_1_75.pdf

30 Note that this does not consider the number of available flights or capacity for passengers to do a same-day round trip, simply whether there is an option to do so for a particular destination.

General Electric (GE) appreciation of post Malév bankruptcy air transport services in Budapest[31]

GE, the American multinational corporation, is present in Hungary with three regional headquarters beside its manufacturing facilities. They are the largest U.S. investor and employer (13,000+) and one of the biggest exporters in Hungary.[32]

According to GE, the airlines which have replaced Malév after its collapse are mainly low cost carriers operating with more inconvenient schedules than their predecessors. Their flights depart either too early in the morning or too late to be able to make use of the working day efficiently at the travel destination. Because of this, GE employees typically need to depart the preceding day but at extra travel cost to the company (e.g. overnight allowances, hotels, etc.).

It is also mentioned that the replacement services provide links to non-business or secondary airports leading to extra time and expenses to bridge the distance from city centre.

Convenience and extra service charging policies of low cost carriers are also not in line with business travellers' expectations (e.g. it is common that extra charges are collected for hand luggage just before boarding).

GE observes that low cost carriers were present in the market before the Malév collapse. GE nevertheless has chosen the network carriers for travelling despite the higher cost due to the convenience of their schedules, services and transfer options.

For long haul travel, GE employees now often fly out through Vienna airport. However, this is a costly and time consuming solution in comparison to former Malév services.

It is noticeable that there are new routes to Middle East destinations that have recently been introduced at Budapest Airport which provide a more favourable option to approach their business interests in these regions.

The changes in the aviation market locally have no direct impact to HQ and investment placements, but it affects conference organisation. An example was provided where a conference of 200-300 attendees (mainly from the US) had been relocated to another location due to connectivity problems.

2.7. Impact on connectivity

This section summarises the changes in connectivity for Hungary based on the measures of connectivity developed in Paper A for business and leisure connectivity. Each measure is explained briefly below.

2.7.1. Business connectivity

Given the importance of flight frequency for business passengers, the business connectivity measure is based on the total number of flights to each destination and each destination is then weighted equally by both:

1) The IATA connectivity measure for the destination airport (seat capacity weighted by the size of the destination airport relative to the airport with the highest rating of the measure) to capture onward connectivity and differentiate between primary and secondary airports.

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31 Interview with GE Lighting chief lawyer, 11 April, 2014

32 Information extracted from company website: http://www.ge.com/hu/en/

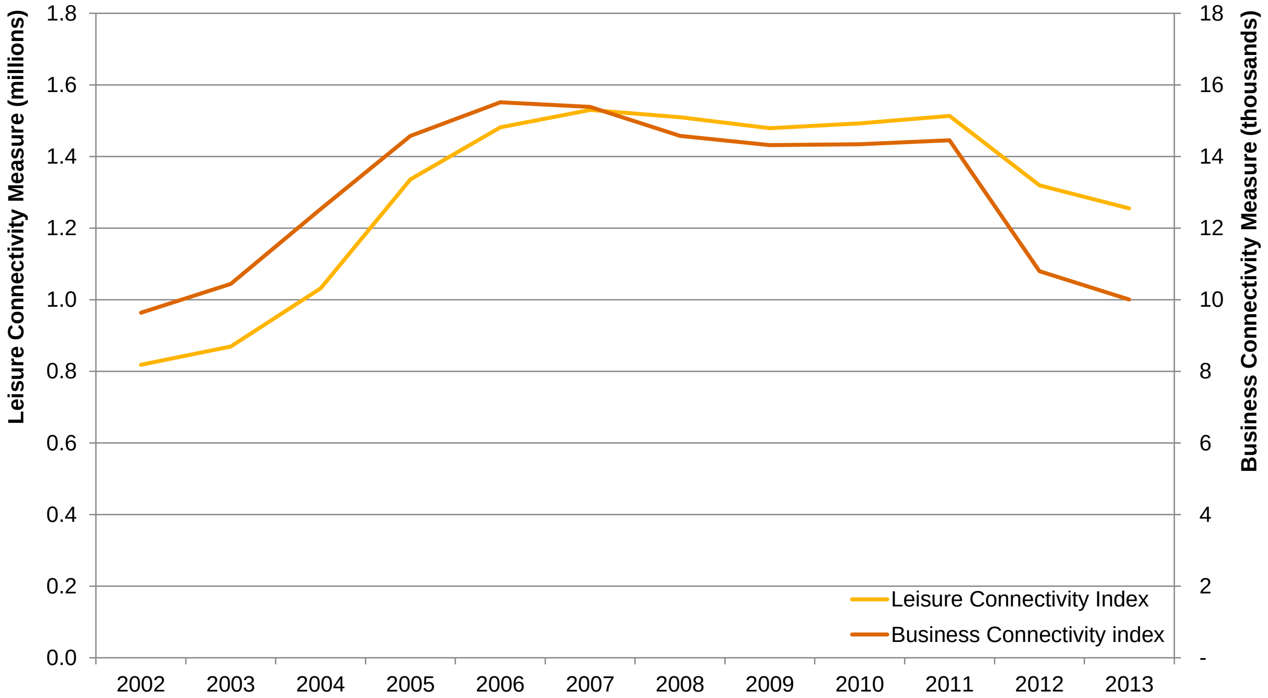
2) The air connectivity index developed by PwC in Paper A, for business and leisure connectivity, which takes into account the value of the destination city for business based on the Globalisation and World Cities (GaWC) connectivity index (relative to the most connected city based on the measure).

2.7.2. Leisure connectivity

As evidenced in the air connectivity index (developed by PwC in Paper A), leisure passengers tend to be more flexible with flight schedules; therefore the leisure connectivity measure is based on total available seats and each destination weighted by the IATA connectivity measure as discussed above.

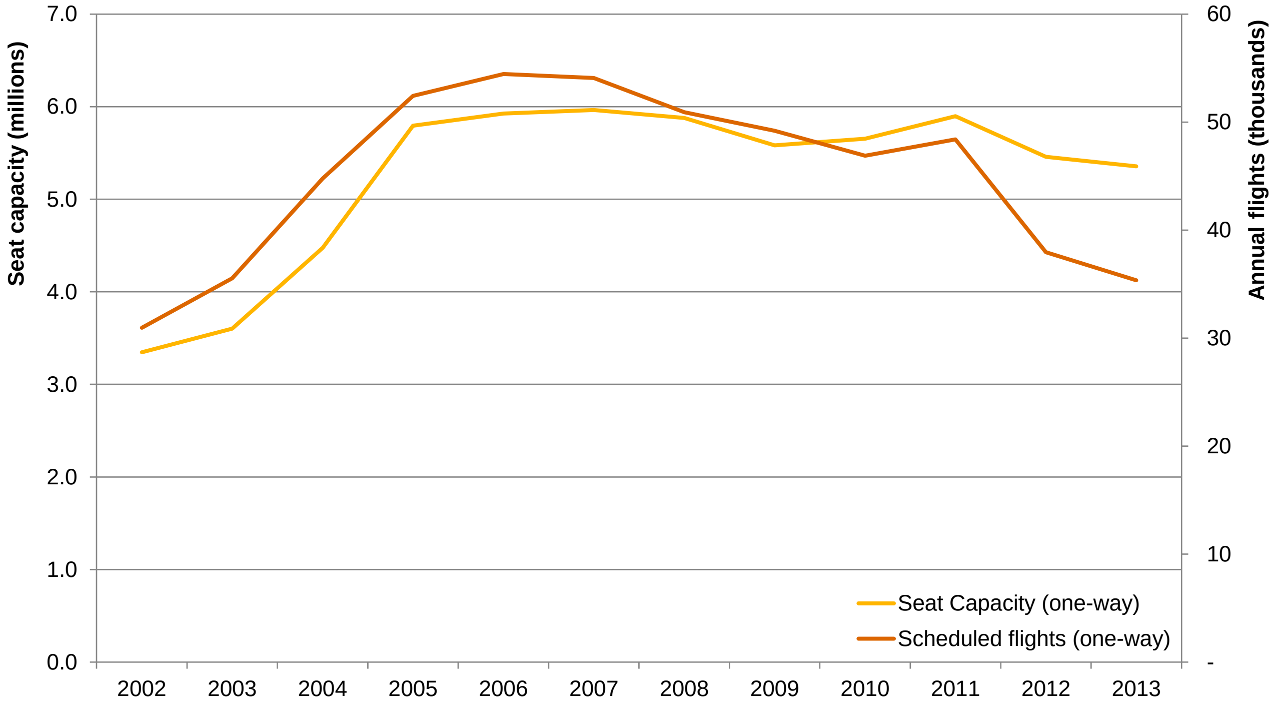
The measures for Hungary are shown in Figure 5. Strong growth was observed both for business and leisure connectivity to 2006 where connectivity stagnated until Malév's bankruptcy in early 2012. While overall available seat capacity was maintained (see Figure 6), the value of the destinations based on the weighting of the IATA connectivity measure (leisure connectivity measure) declined, indicating that the replacement capacity is to smaller, less connected destination airports. The number of flights dropped following Malév's bankruptcy, reflective of the higher capacity aircraft replacing the lost services (e.g. high capacity narrow body aircraft from Wizz Air and Ryanair). Frequency is of particular importance to business travellers and the business connectivity measure reflects the decline in the number of flights and the value of the destination both in terms of the destination airport's size and connectivity and the destination city's business connectivity.

Figure 5 – Measures of connectivity from airports in Hungary



Source: Sabre ADI data (2014), PwC analysis

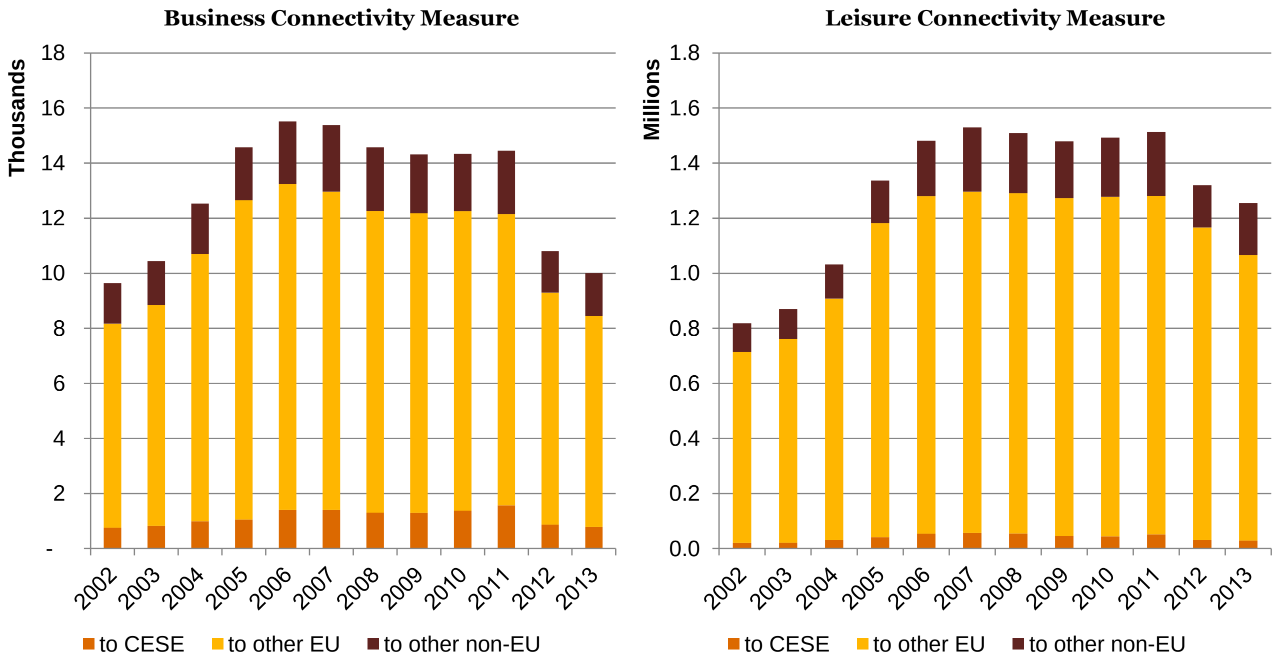
Figure 6 – Scheduled capacity from airports in Hungary (one-way)



Source: Sabre Airport Data Intelligence capacity report

As discussed in section 2.5 above, replacement services also focused more on thicker routes outside the CESE region (primarily EU15) as most capacity was replaced by LCCs operating with higher capacity aircraft. This led to a decline in the number of routes operated and therefore to a decline in air connectivity within the CESE region. This is reflected in the maps shown in section 2.6 and the figures below.

Figure 7 – Measures of connectivity from airports in Hungary by destination region



Source: Sabre ADI data (2014), PwC analysis

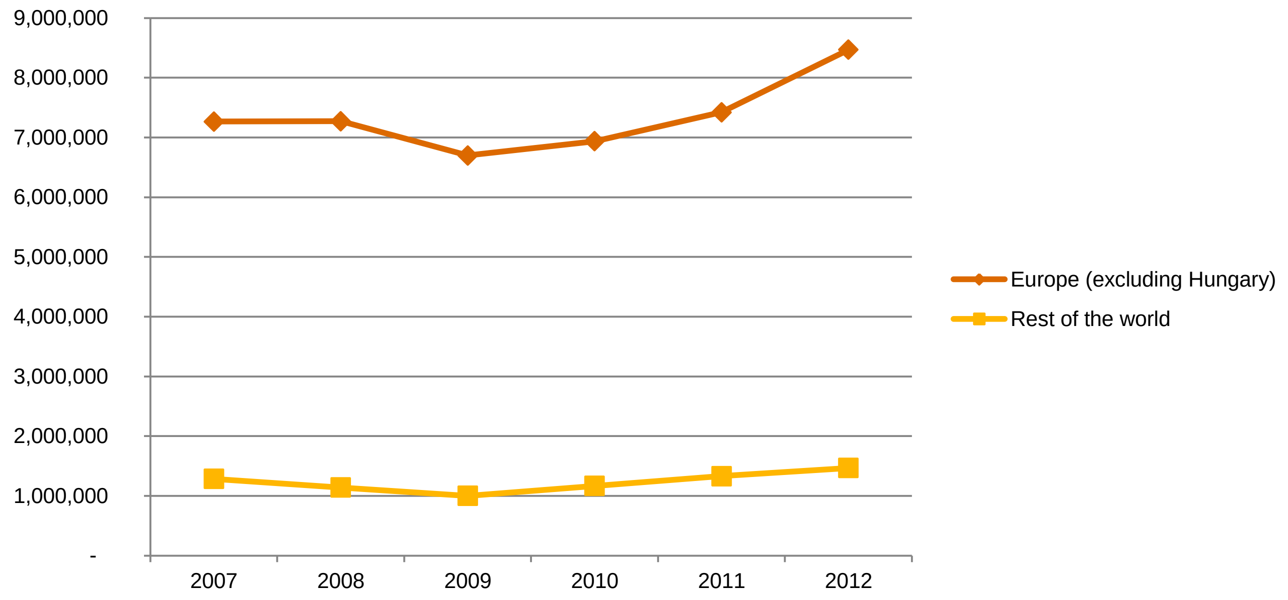
2.8. Tourism sector and inbound travellers

Inbound air travellers generate positive economic effects because of their expenditure on services and products in the local economy. For the purposes of this analysis, these travellers can be divided into three categories according to their main purpose of travel:

- Leisure: visitors which travel for tourism but also for shopping, medical treatment, spa and wellness
- VFR: visiting friends and relatives
- Business: travelling for work but also for business tourism, conferences, etc.

Before Malév's collapse, the Hungarian tourism sector was on a positive upward trend. According to Eurostat data, in 2012 the number of nights spent in hotels and similar accommodation by foreign visitors rose by 13.5% compared to 2011.[33] As shown in the plot below, the increase was more marked with regards to European visitors, who spent almost 8.5 million nights in accommodation in Hungary (a 14.1% increase on previous year). This may in part be due to the decreased convenience of airline schedules and increased requirement for hotel nights to conduct a business trip to Budapest. In addition, visitors from non-European countries presented an increasing trend, marking a 10.3% increase on the previous year. Visitors from non-European countries accounted for approximately 15% of total foreign tourism in Hungary.

Figure 8 – Number of nights spent by foreign visitors by their region of residence



Source: Eurostat data (2014), PwC analysis

Despite the quantitative facts concerning passenger numbers at Budapest Airport, the demographics of passengers have changed. The leisure and VFR traffic substituted a substantial proportion of business traffic, which is assumed to have generated a greater economic impact for Hungary.

According to Tensi Tours Ltd.,[34] the high yield tourism sector has been severely affected and has almost disappeared from the local market, while tourism for business events and conferences has also declined

33 Note that tourism figures for 2013 are not yet available.

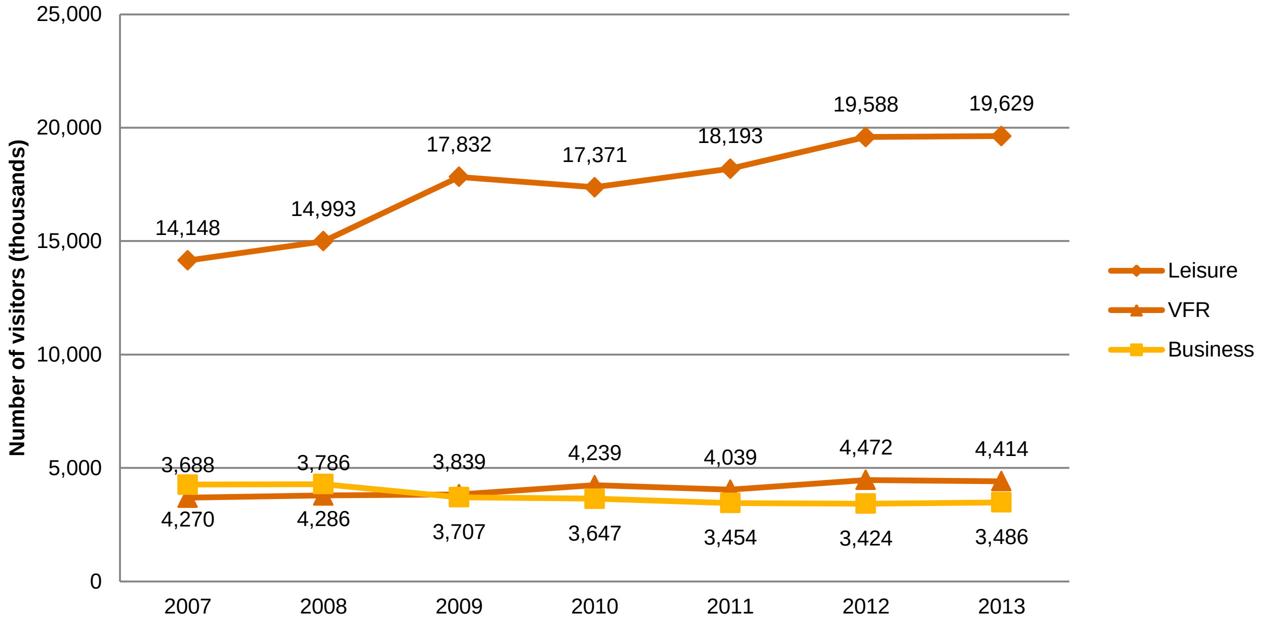
34 Interview with Mr. Tamás Déri CEO and co-owner of Tensi Tours Ltd.; Mr. Barna Tarnóczy, MD of Tensi Aviation Ltd. – One of Hungary's main travel agencies and charter lessors.

considerably. Indeed, most of the long-haul destinations from Budapest Airport were terminated subsequent to the collapse of Malév and re-launching long-haul services without a feeder airline seems unlikely. The opinions of local experts are partially supported by statistics published by the Hungarian Central Statistical Office (KSH).

As shown in Figure 9, the number of foreign visitors for business purposes has not been affected by Malév's bankruptcy; rather a significant decline was observed in the years before the bankruptcy. This was driven by the business tourism segment, with foreign visitors travelling for congress and conference[35] declining by 30.3% year-on-year in 2012 and by a further 14.2% y-o-y in 2013.

In contrast, leisure visitors and VFR travellers have likely benefitted from Malév's collapse with the consequent expansion of low cost carriers providing competitive fares. Whilst this report focusses on air connectivity, it is important to note that, for short-haul destinations, land transport can provide strong competition for air transport (and is generally more competitive for journeys under 3 hours). Note that the below figures do not distinguish between foreign visitors travelling by air or travelling by land.

Figure 9 – Foreign visitors in Hungary by main motivation of travel (thousand persons)



Source: KSH data (2014), PwC analysis

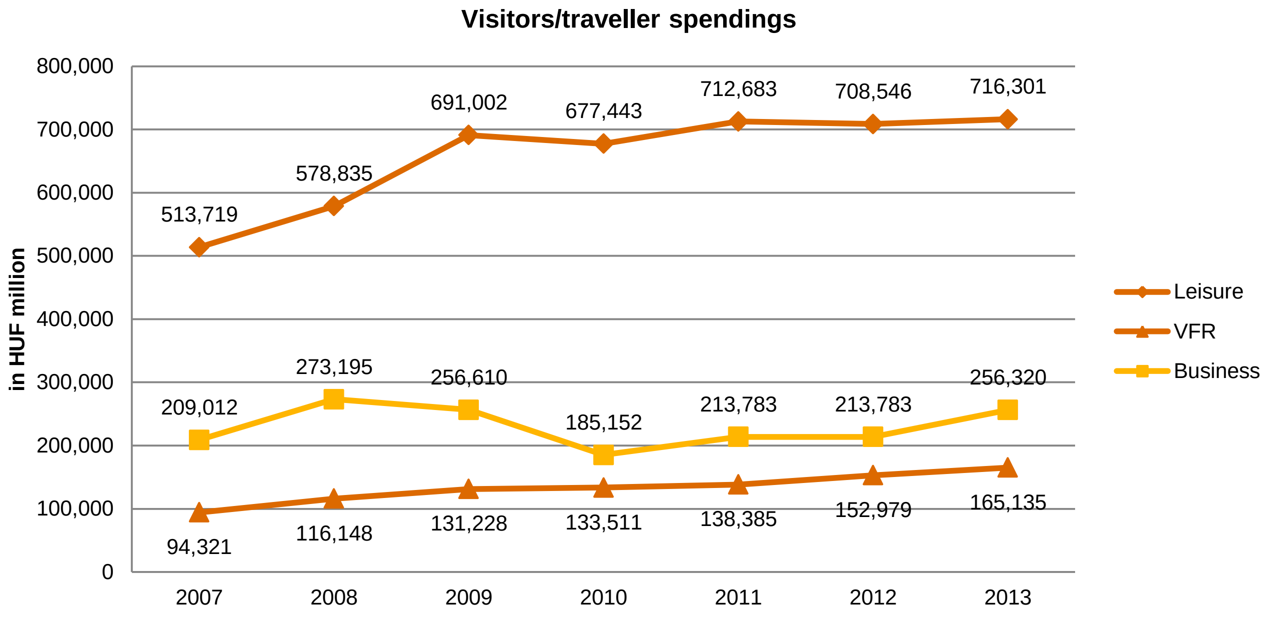
As shown in Figure 10, the effect of Malév's bankruptcy on the Hungarian economy was measured by looking at consumer spending. Total air travellers' spending declined by 0.6% in 2012, before fully recovering in 2013. The majority of spending is provided by leisure visitors, which comprised around 70% of total spending in 2013. VFR travellers' spending shows a long term positive trend, which appears to be unaffected by Malév's bankruptcy. Similarly, business travellers' spending was not affected by Malév's bankruptcy, with a step increase of 19.9% in 2013.

Overall, there is no tangible evidence that the Hungarian tourism industry benefited from Malév's bankruptcy, or the subsequent low cost carriers expansion. Leisure tourism has increased in terms of the number of visitors but did not translate into a substantial and incremental increase in consumer spending with negligible impact and effect on the real economy. Business travellers marked a clear growth in terms of spending but the actual number of visitors did not change. Hence, there is no obvious correlation between consumer/traveller numbers

35 The congress and conference visitors only account for 0.3% of overall business visitors.

and spending with Malév's bankruptcy.

Figure 10 – Spending of foreign visitors by purpose of travel (million HUF)



Source: Elaboration on KSH data (2014)

2.9. Reallocation of air traffic rights

2.9.1. Regulatory background

Regulation 847/2004[36] lays down a set of principles designed to ensure an adequate exchange of information within the EU, so that Member States, in their bilateral relations with third countries in the area of air services, do not risk infringing EU law. In particular, it requires Member States to ensure that where a Member State concludes an agreement with a non-EU country that provide for limitations on the use of traffic rights or the number of Community air carriers eligible to be designated to take advantage of traffic rights, that Member State shall ensure a distribution of traffic rights among eligible Community air carriers on the basis of transparent and non-discriminatory national procedures.

2.9.1.1. EU Designation

EU designation provides that external partners will accept the designation by an EU Member State of any properly licensed EU carrier, established but not necessarily owned and controlled in that Member State,[37] to operate traffic rights available under their air service agreements with the EU or its Member States.

Under the Horizontal mandate granted by the Council and by co-ordinating amendment of individual Member State agreements, the EU has conducted a global negotiating effort that by April 2012 has embraced some 117 countries while amending some 969 air services agreements. These results have enabled both more growth and more consolidation than was possible before 2004 under the classical bilateral agreements.

36 Regulation (EC) No 847/2004 of the European Parliament and of the Council of 29 April 2004 on the negotiation and implementation of air service agreements between Member States and third countries

37 But owned and controlled by EU or EEA interests

- **Growth opportunities.** Properly established EU operators now can compete on routes previously reserved to airlines owned in the individual Member States which has led to new entry by traditional airlines and no frills carriers, the latter most notably in the European neighbourhood area.
- **Consolidation and network development.** Acceptance of EU designation by external partners has at the same time facilitated the network development of the major airlines by enabling their ability to merge cross-border and retain previous rights.

Unlike other cases, the issue of EU designation for Hungary has been much more than bringing ASAs[38] in line with EU law. It has been a critical issue following the collapse of Malév since Hungary does not have any airline which is owned and controlled by Hungarian interests to designate. The airlines that have shown interest in designation under ASAs between Hungary and non-EU states are Wizz Air and Travel Service Hungary, neither being Hungarian owned and controlled.

2.9.2. The practical effect of non-implementation

The absence of such procedures could prevent an EU air carrier registered outside Hungary from competing for traffic rights between Hungary and non-EU countries. This results in a potential exclusion from the market of EU air carriers wishing to operate in Hungary, and thus infringes the very principles of the common EU aviation market.

Although, the EU rules are probably efficient to ensure a fair and transparent air traffic rights distribution, it is limited as it does not provide the possibility of containing the negative social and economic impact an airlines collapse can have – as it does not indicate for instance the timing of such rights re allocation, especially in the case of an airline bankruptcy.

2.9.3. Implications of Malév's collapse

Due to the common aviation area in Europe, any EU-carrier may operate services between any EU destinations if there are slots available, therefore most European connections were immediately recovered following the collapse of Malév. However, for certain non-EU destinations, bilateral aviation agreements regulate the services between two States in terms of capacity and carriers that can operate. For a certain period, restricted markets such as Russia, Turkey, Ukraine and Israel were left with limited services operated by third country carriers or no services at all before EU designation was negotiated with the countries concerned and traffic rights were allocated through the national procedure. This led to a loss of traffic to these markets with the main beneficiaries being Vienna and Prague, both of which have been liberalising flights between their countries and non-EU markets.

Amendments to the air services agreements took time (around one year following the collapse) – in the meantime, non-EU carriers enjoyed a monopoly on these restricted routes.

The Hungarian Government struggled for a long time to make Russia accept the designation of Wizz Air and potentially EU designation more generally. Turkey has consistently refused to accept EU designation and Wizz Air currently flies under charter permission and on 'extra-bilateral' basis which allows Turkey to withdraw the permission at any time. The maximum number of flights that can be offered by the airlines of the two parties are unequal leading to unfair competition. So far no solution has been found for the EU designation issue with Turkey.

Ukraine and Israel accepted Wizz Air's designation under the respective ASAs and horizontal agreements which demonstrates the value of horizontal agreements. In both cases, the Hungarian Government managed to get confirmation from third countries before the bankruptcy of Malév that they would apply EU designation.

In order to maintain connectivity, and ensure the continuity in consumer benefit (without mentioning the urgency in containing the risk given the implication the collapse has for BUD airport business continuity),

38 ASA: Air Services Agreements

immediate action that could have been taken would have been to assign the traffic rights for non-European routes to interested airlines as quickly as possible so that the routes can continue to be served. This should have been the case before Malév's collapse, in 2008, when long haul routes were no longer covered by Malév; and also in 2012, just after Malév's bankruptcy.

After the grounding of Malév, the Hungarian Civil Aviation Authority invited for a tender to designate new carriers for the regulated routes (again the timing of such tenders was unclear) – for Moldova, Turkey, Russia, Ukraine and Israel. We were able to find the system of criteria on which the State judged the offers made by various airlines – percentages are indicated for each criterion to reflect the weight with which the given criterion is considered during the judging of the request by the State. Examples of possible criteria are included in Appendix 1.

But it is only after BUD Airport exerted pressure on the State, that the first flight to Tel Aviv took place based on the former Malév traffic rights. Wizz Air finally acquired the traffic rights for that specific route, with all other routes being slowly reallocated among the airlines that presented an interest. However, an accelerated tender to allocate the unused traffic rights would have been probably justified; and could have contributed to contain the risk and large consequences of Malév's collapse.

But, according to various press releases, the State did not take any tangible actions in the first weeks following Malév's bankruptcy, possibly in the assumption that a new national carrier could emerge. But, today, some former Malév destinations remain orphaned, simply because they do not fit with the business concept of low-cost carriers. This has severe implications in terms of connectivity, passenger benefit and experience. In addition, the lack of a network carrier at BUD airport precludes its ambition to become an important regional hub airport. BUD airport has endeavoured to win back destinations that have been lost. It managed to gain connections to Copenhagen and Oslo through SAS. The airport was, and still is, in contact with a lot of airlines and is working intensively to persuade airlines to include Budapest as a destination in their flight schedules. Nevertheless Budapest remains cut off from numerous important business destinations and regions as there are limits to what the airport itself could do to fill those gaps.

While it is difficult to examine in full the measures that were taken by the Hungarian Government to re-allocate traffic rights used by Malév before its bankruptcy, given the limited information publicly available, it seems however that the main lesson that can be drawn is the timing of the implementation of such measures and probably also the lack of coordination between the Government and the airport. Indeed, it is likely that the Government did not fully appreciate all the consequences and challenges of Malév's bankruptcy on Hungary's connectivity.

2.10. Winding down of operations to avoid stranded passengers

2.10.1. Overview

Airline bankruptcy became a common phenomenon in Europe, especially in the last decade. With the sudden interruption of operations being often the result of air carrier's financial problems and/or the revoking of its operating license. We are conscious that the Commission has undertaken at least two studies on the issue of passenger protection in the event of airline bankruptcies. We therefore confine our analysis to a description of the impact of the sudden cessation of services on passengers, and of various mechanisms that exist to mitigate impact.

Consumers facing airline bankruptcies, however, are not always protected, as there are cases in which passengers were stranded abroad or not compensated. The existing legal framework of the European Community does not contain any specialised provision,[39] although there is Community legislation on the monitoring of airline finances, travellers' rights, and insolvency proceedings. Our intention is to evaluate, again by looking at Malév's winding down process, the impact on consumers.

39 Notwithstanding the package travel directive, which does provide protection and repatriation in the event of stranded passengers who have purchased a "package", rather than solely an airline ticket.

The total impact and costs for consumers/passengers who have booked to travel with an airline that suddenly ceased operations vary depending on whether it ceased operations before the flight was booked or after an outbound flight and before the inbound flight.

The impact on passengers could be measured in terms of incremental costs for the passenger to bear:

- Information (cost of phone calls to rebook flights).
- Care (including additional accommodation).
- Original flight(s) (reimbursement).
- Replacement flight(s) (for repatriation or for replacement travel).
- Non-refundable components (such as hotel or car hire deposits).

If the airline operations ceased before the outbound flight, then the passengers would choose between:

- Rearranging the trip via other means (paying additional cost for alternative travel, which is likely to be more expensive, particularly if booked at short notice).
- Forgoing the trip (they forfeit any non-refundable components of the trip (such as accommodation or car hire), as well as the cost of the original air ticket.

In contrast, if the airline operations ceased after an outbound flight but before the completion of the inbound flight, then passengers are stranded and will have to find alternative travel in order to return home, which will usually be at very short notice and hence on average much more expensive than the original ticket. Moreover, passengers may have to arrange additional accommodation and other costs.

The issue this raises is that the reimbursement of the booked tickets to passengers bears on the insolvent airline itself. The credit of passengers ends up within the liabilities in the airline's balance sheet, and the credit will be considered as unsecured – if there is no cash and liquidity, then nothing really can be done from the insolvent airline perspective.

2.10.2. Existing remedies available to passengers

In recent years, Scheduled Airline Failure Insurance (SAFI) has allowed passengers in some EU Member States to insure themselves against some of the costs resulting from the insolvency of an airline on which they are booked.

In addition, the Package Travel Directive[40] provides protection for passengers purchasing package tours in the EU. This requires organisers/retailers to be able to refund money paid over and/or cover repatriation of consumers in the event of insolvency. However, this protection is limited to consumers purchasing a package, defined as a pre-arranged combination of transport and at least one other significant tourist service. This excludes purchases of air tickets alone.

In some Member States, consumers who purchase tickets with credit cards (and also some debit cards) are allowed to claim a refund from the card-issuing bank in the event of insolvency of the airline. However, the reimbursement is limited to the cost of the original tickets and in some cases is subject to a minimum value.

Furthermore, if tickets are purchased via IATA travel agents, the payments for them are held by a central payment mechanism before being passed on to the airline, in settlements at regular intervals (usually monthly). Therefore, if the airline becomes insolvent, passengers whose payments have not yet been passed on to the airline should be able to recover what they paid.

Other forms of protection are available in some Member States, namely:

40 Council Directive 90/314/EEC of 13June 1990 on package travel, package holidays and package tours

- Denmark – A fund (the Rejsegarantifonden) which provides protection under the Package Travel Directive has been established and recently (2010) extended to offer passengers the option of this protection on all flights from Denmark on carriers established in Denmark.
- Belgium – According to a decree entered into force in 2007, airlines registered in Flanders are required to hold an insurance guarantee against insolvency.

2.10.3.Measures taken by Malév[41]

The Hungarian Government adopted a Decree (5/2012) on 31 January 2012 providing the possibility to claim for refunds for passengers with tickets for outbound or inbound flights that were supposed to be between the 3rd and 6th February; and for passengers with a return ticket, the inbound flight would need to be scheduled at the latest by the end of February 2012.

The Decree did not provide for re-routing. In order to complete their travel initially booked on Malév, passengers had to find and purchase another air ticket. Some airlines proposed special alternative fares between EUR 34-60 (one way), but only for specific routes, with a limited number of seats available and on specific dates. Passengers had some difficulties finding suitable alternative transport and had to purchase replacement tickets at higher fares at short notice, with the initial ticket refund being limited to certain conditions and being exclusive of all other incremental and related costs generated by the insolvency.

It is important to stress as well that only a small proportion of passengers affected by Malév's failure were covered by the Decree, considering that an airline issues tickets for travel scheduled up to 11 months ahead. As often happens when an airline is in financial difficulty, just before ceasing operations Malév had sold an unusually high number of tickets, including for travel far in the future and therefore not covered by the Decree. Passengers which were not covered by the Decree were not refunded and essentially paid twice to travel.

Whether covered by the Decree or not, passengers had to bear any unforeseen catering or accommodation costs depending on the replacement transport schedule.

Some passengers who paid for their tickets by credit card managed to stop or cancel the payment depending on their type of card and the provisions of local law (country of purchase) on credit card payments.

2.10.4. Measures taken by IATA

For Malév tickets initially purchased via a travel agent holding an IATA accreditation, IATA required agents to remit to IATA all amounts resulting from the sale of Malév tickets in January and up to early February 2012. IATA indicated that it had negotiated an agreement with Malév, under which the money collected from agents would be used to refund passengers. IATA has received some 100,000 requests for refunds (this only concerns tickets booked via an IATA accredited agent).

Starting from March 2012, however, IATA indicated that it needed the approval of the bankruptcy administrator to process refunds as it encountered difficulties in obtaining approval; which also increased the risk that passengers receive no refunds under the IATA Agency Programme. This confirms that the protection derived from the operations of the *IATA Billing and Settlement Plans (BSP)*[42] has its limitations as it depends on the airline or the bankruptcy administrator.

Hence, squeezed between the regulators and the operators, consumers are not necessarily the winner but beneficiaries are likely to be Malév's rivals.

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41 Source: ECIAA, The European Travel Agents and Tour Operators Associations

42 The BSP system is designed to facilitate and simplify the selling, reporting and remitting procedures of IATA Accredited Passenger Sales Agents, as well as improve financial control and cash flow. Source: IATA website

2.10.5. Measures taken by other airlines

Malév's 'stoppage'[43] immediately affected some 7,200 passengers: 3,500 in Hungary and more than 3,700 abroad who had been expecting to board Malév flights on Friday – for instance, two of Malév's aircraft were prevented from taking off from Dublin and Tel Aviv, prompting the decision to ground all Malév aircraft worldwide. Malév said it had contacted other airlines in search of help for the stranded travellers.

Rival low-cost airlines EasyJet and Wizz Air quickly moved to take advantage of the Hungarian airline's demise, offering 'rescue package tickets' to passengers due to fly with Malév for about EUR 60.[44]

Filling in the capacity gaps left by Malév's collapse, airlines including British Airways, Air France and KLM increased their frequencies on existing Budapest flights, while Lufthansa, Wizz Air and Air Berlin announced new routes. The most significant development came when Irish airline Ryanair stepped in with an ambitious 'rescue plan'.

Ryanair took advantage of the unfortunate developments in Hungary, by opening a new base in Budapest following the bankruptcy of Malév (and at Barcelona and Madrid following the closure of Spanair). Ryanair announced that it would base four Boeing 737-800s at Budapest from 17th February and would commence operations on 31 new routes.

2.11. Attempts to establish a new airline

2.11.1. Background and chronology

Sólyom (Falcon) Hungarian Airways proposed to commence service in Hungary with six aircraft in August 2013.[45] The carrier had ambitious growth plans, as it sought to growth its fleet to 25 aircraft by the end of 2014 and 50 by the end of 2017, including 10 wide-body aircraft. It expected to employ around 700 employees initially, increasing to 3,000 depending on its growth trajectory. The carrier, while positioning itself as the new national airline, was not meant to have any state involvement; rather it had support from Middle Eastern investors. The carrier expected to handle around eight million passengers by 2017.

The airline signed a lease agreement for six aircraft, with the first to arrive in Budapest before 20th August 2013.[46] The airline planned to move into its offices at Budapest Liszt Ferenc International Airport on 17th July 2013 and the airline's first flight would depend on when it received a permit from the Hungarian National Transportation Authority Air Transportation Directorate. Sólyom Airways was planning to operate premium services and aimed to carry as many passengers as former national carrier Malév Hungarian Airlines. Sólyom Hungarian Airways' initial routes were revealed with the airline planning to serve Amsterdam, Brussels, Frankfurt, London, Milan, Paris and Stockholm from Budapest.

While Sólyom Airways was backed by investors from Hungary, Oman and the UAE,[47] Nemzeti Közlekedési Hatóság (NKH), the Hungarian national transport authority, reportedly partly rejected the application made by the airline for a licence. Sólyom Investment and Asset Management had earlier acquired Avicraft which was licenced to operate ultralights and gliders. Sólyom Airways had requested NKH to extend the licence to commercial transport, however NKH stated the airline must apply for a new licence.

43 The Guardian, press release Friday 3 February 2012

44 The Guardian, press release Friday 3 February 2012

45 fluege.de, 10-Jul-2013

46 MTI, 17-Jul-2013

47 Reuters/Népszabadság, 22-Jul-2013

Hence, Sólyom Hungarian Airways delayed its entrance into the market; and ending up filing for bankruptcy on October 2013.[48] The start-up carrier had failed to secure a contract with an unspecified Oman-based investor leading to a cash shortage. The company consequently failed to pay staff salaries.

Sólyom Hungarian Airways has appointed a new managing director to focus on air charter services, but it will still need to obtain its air operator's certificate to launch service for the ad hoc charter market. The management estimated the company would require less than EUR 1 million in start-up costs in order to complete its launch. But raising the funds required currently seems to be a major issue facing the airline.

Hungarian World Airways was incorporated on September 2012. The carrier's short-term plan was to launch services from three European hubs and two US hubs with up to 130 daily departures. The carrier's long-term plan included launching services to Africa, Asia and Australia with a fleet of A320, A330-200s and A340-500s. At present, it is still unclear if the airline will launch operations.

2.11.2. Viability of proposals

It is frequently the case that proposals for start-up airlines (in any country) do not have a robust business case, and such proposals come to little. The following recommendations from Boeing outline many of the issues that need to be considered.[49]

Start-up carriers are entering the market in most places by taking advantage of the interesting aircraft leasing and/or acquisition opportunities, as well as airline failures and/or capacity reductions by rivals in some markets. Several of the new carriers are sometimes the result of cross-border expansion by airlines in emerging markets.

Starting an airline is tough. Running a profitable airline is even tougher. From start-up airlines to established industry leaders, the process involves constant learning and adaptation.

Few businesses have as many variables and challenges as airlines. They are capital-intensive. Competition is fierce. Airlines are fossil fuel dependent and often at the mercy of fuel price volatility. Operations are labour intensive and subject to government control and political influence. And a lot depends on the weather.
In order for the business to take off, a pre-flight checklist is needed:

- What's the outlook for passenger and cargo traffic?
- Knowledge of up to date international agreements and standards for commercial aviation.
- Business planning, competition, brand development?
- Choosing the right airplane?
- New or used airplanes to purchase or lease?
- Availability of funding, exchanges rates, oil, country risk?
- Crew training, maintenance, spares, IFE, configuration, interiors, etc.?

All of the above will be a condition for a successful start-up airline project.

In the case of Sólyom Hungarian Airways, it is difficult to assess the project in full as we don't have access to their business plans and figures (as this is not a publicly available). News and press releases, however, suggest that there were significant weaknesses in planning.

It is unclear whether the airline fully appreciated the strong market share of its potential and already established rivals; and if it thoroughly evaluated if Hungary as a country had a strong case for growth, with high GDP growth rate, GDP per capita and propensity to fly.

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48 *Budapest Business Journal*, 24-Oct-2013

49 See http://www.boeing.com/boeing/commercial/startup/

2.11.3. What are the prospects for a new network carrier operating from Budapest as its hub?

Any new airline needs to firstly assess whether there is an economic case supporting growth in the country; which is one condition (among others) to get investors interested and attracted to support the airline project. Hungary appears to be one of the bright spots in the region when it comes to air travel (GDP per head, propensity to travel and aircraft orders).

However, the LCCs have changed the aviation landscape in Hungary, especially since the collapse of Malév. Unless the longer-established European airlines are able to reinvent themselves, the LCC sector has potentially 'irreversibly' captured a substantial market share. As long as the LCCs expand at the same rate as network carriers are contracting capacity that advantage will continue to grow.

While the Hungarian Government may believe that the country can support a full-service network carrier, this may ultimately prove to be challenging.

Hungary is a relatively small market and at the time of its collapse, Malév was only a short-haul operator, serving over 40 destinations with an all-narrow-body fleet of 22 aircraft (including 18 Boeing 737s and four Bombardier Dash 8 turboprops). Neighbouring Slovakia, for example, currently has an LCC penetration rate of over 70% and no longer has a flag carrier.

Most of the void left by Malév in the local market (excluding Malév's transit passengers) can be and has been filled relatively quickly by the fast-expanding LCCs. Several European flag carriers also added capacity at Budapest as they looked to take over Malév's local premium traffic as well as the carrier's long-haul passengers, who were primarily connecting at larger European hubs onto long-hauls flights operated by Malév's partners. But the premium and long-haul portions of the local Hungarian market are clearly much smaller than the economy short-haul portion.

Wizz Air is well positioned to fill the void left by Malév. In fact, a market without Malév is likely a scenario Wizz Air management had pondered since Wizz Air's establishment in 2003. Wizz Air until now has not been able to pursue rapid growth in its home market, prompting it to establish other bases throughout Central and Eastern Europe. Prior to the Malév grounding, Wizz Air accounted for 10% of capacity (seats) in Hungary with only three A320s based at Budapest, which contrasts with its current dominant position.

While Budapest Airport had aspirations of competing with hub airports such as Prague, Vienna (only 260 km away) and Warsaw, this is now unlikely to materialise without a hub carrier. Hence, the prospect of Budapest Airport operating as a hub airport is currently very unlikely.

Market and Econometric analyses

3. Introduction

3.1. Context

3.1.1. European Airlines performance

European industry profit is amongst the world's weakest and is well below the global average. According to IATA, European airline margins - measured by operating margins - have underperformed other regions for a number of years. With 2014 forecast by IATA to be yet another year in which Europe is the least profitable major region for airlines, strategies for survival continue to be under focus with state aid rules still being a hot topic. IATA figures show that the average margin for Europe from 2009 to 2012 was just 0.3%, lower than for any other region and more than 2ppts below the global average of 2.4%.

Very few Eastern European airlines were left unscathed, with major airlines from Hungary, Latvia, Estonia, Poland, Slovenia, Ukraine and Czech Republic either launching restructuring processes or shutting down operations. As a result of these restructurings and failures of vulnerable network flag carriers, airline networks across the region have been reduced.

The 'national' network carriers have often struggled to maintain sufficient profitability to support capital investment. Airlines have faced increasing short to medium-haul competition from the Low Cost Carriers (LCCs). Some of these problems have been exacerbated by a legacy of poor productivity and other cost issues (such as pension and labour costs). In Europe, government intervention (now largely illegal under EU rules) has kept struggling "flag carriers" in business.

In this context, State Aid has been a hot topic; with several airlines from the CESE being under investigation in accordance with the Guidelines on Rescue and Restructuring Aid. Concerns had been raised by some Member States that their economies could lose connectivity in the event their airlines were to follow the fate of Malév.

This highlights the need to understand the effects of airline financial distress and bankruptcy at a national level in terms of connectivity, capacity/frequencies and fares (i.e. consumers benefits), as well as to assess whether the financial distress results from inefficient airlines operations and strategy, from the causal effect of weakened demand, or from cost shocks that lead to both service declines and financial distress.

3.1.2. LCC emergence

The European region's airlines – in particular airlines in the CESE region – are suffering from low profitability, with the second lowest net margin of all the world's regions.[50] This reflects the liberalised internal market of the European Union (its aviation market and other markets, including that for labour), and the consequent development of the LCC sector.

The LCCs emergence and strong presence has contributed to significant change in competitive landscape in the CESE regions. Many incumbent airlines struggled and are still struggling with numerous airline cessations in and around the region as shown in Table 7 overleaf.

50 source: CAPA, 11th of July 2014

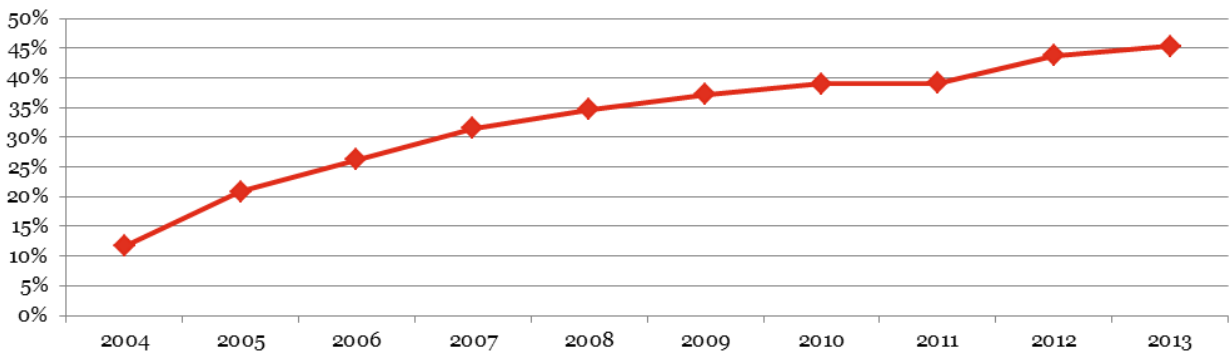
Table 7: Defunct airlines in and around the CESE region

Country	Defunct Airlines
Bulgaria	Air Max, Balkan Bulgarian Airlines
Croatia	Adria Wings, Air Adriatic, Dubrovnik Airline
Czech Republic	Czech Connect Airlines, Fisher Air
Estonia	Aero Airlines, Air Livonia
Hungary	Malév
Latvia	Latvian Airlines, Baltic International
Lithuania	FlyLal, Star 1
Poland	Central Wings
Romania	Romavia
Slovakia	SkyEurope, Air Slovakia, Slovak Air, Tatra Air
Slovenia	Slovenian Spirit
Serbia	Centravia
Albania	Albanian Airlines, Belle Air, Ada Air, Albatros
Macedonia	MAT, Airlift Service, Palair

Sources: various press releases and PwC analysis

Low cost carriers have significantly expanded their operations in the CESE region. Where travel involves a CESE country, either as its origin or final destination, the growth of low-cost carrier is evident.

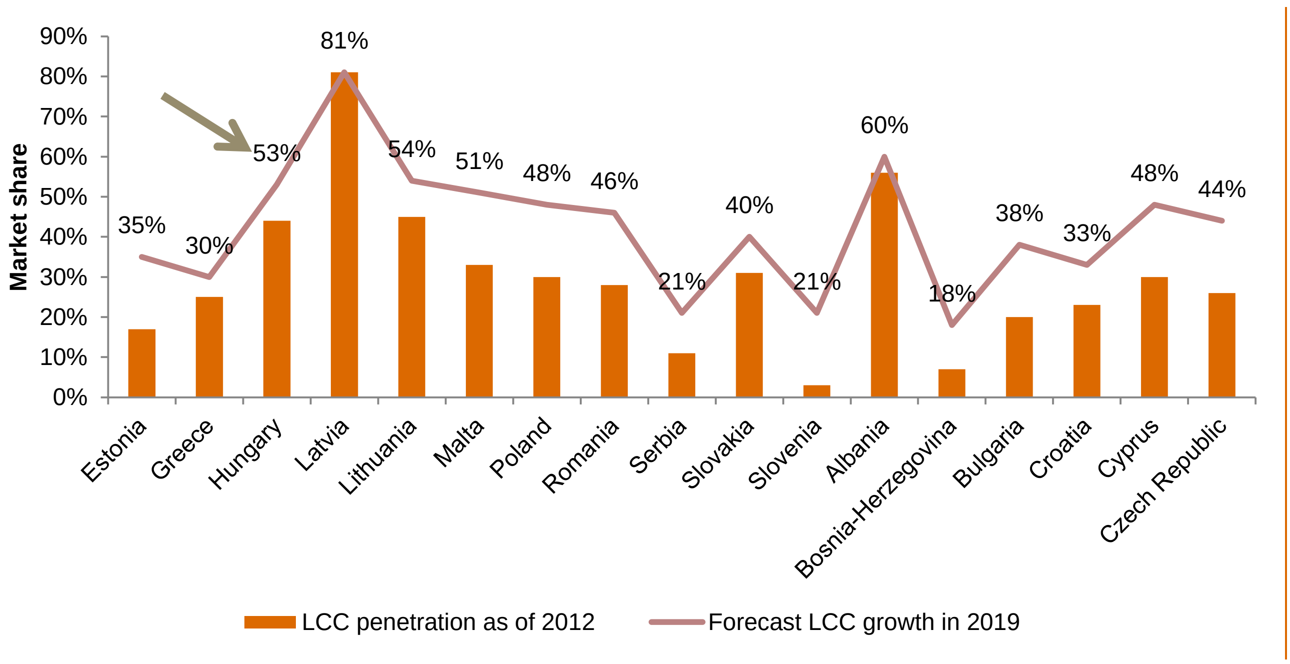
Figure 11: LCC market share where the origin, final destination or both is a CESE country



Source: PwC analysis and Sabre ADI data

The above graph shows expansion of low cost air travel on intra-CESE routes, from just over 10% of total seats in 2004 to 46% in 2013. According to Eurocontrol forecast, this trend is expected to continue in the region with Albania and Latvia showing the strongest rates (actual and forecast) of 60% and 81% respectively.

Figure 12 – LCC share of flight movements and growth in CESE region, 2012 vs forecast 2019

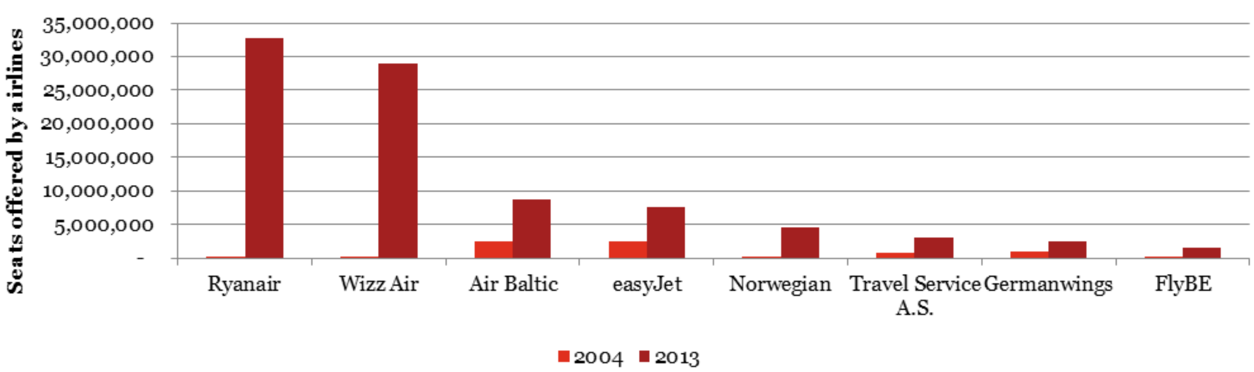


Source: Eurocontrol - 7-year IFR Flight Movements and Service Units Forecast: 2013-2019

There are many factors which may have contributed to the increased presence low-cost carriers have established in the CESE market. Competitive air fares prices have certainly appealed to consumers whilst low-cost carriers may also be able to offer a range of destinations which may not be viable for a network carrier to operate.

The analysis of seat capacities offered in 2004 and 2013 indicates that there are two key airlines which have driven the growth of the low-cost market in this region: Ryanair and Wizz Air.

Figure 13 – Capacity offered by LCCs in the CESE region (origin, final destination or both) in 2004 and 2013



Source: PwC analysis and Sabre ADI data

Amongst the low cost sector Ryanair and Wizz Air are the two most prolific carriers in 2013, having expanded their capacity offer rapidly and now control of over 60% of the low-cost carrier market.

Airlines bankruptcy is also paving the way to a stronger LCC presence at a national level. This has been observed in Hungary, with both Ryanair and Wizz Air expanding operations shortly after Málev's collapse.

3.1.3. Hungary

Hungary, with the collapse of 66-year-old Malév Hungarian Airlines, appears as an interesting case study that could reveal what can happen in a Central Eastern and South-East European (CESE) country should a "national" airline collapse.

The bankruptcy of Malév, the Hungarian national carrier, left a significant gap in the market, affecting consumers in terms of connectivity, flight frequencies, fares, service quality, and service/airline choice. The gap left by Malév was filled very quickly by low-cost carriers including Hungary's Wizz Air and Ireland's Ryanair. In this context, it is likely that Malév's strategy before the collapse consisted of reducing capacity with a focus on improving unit revenues and yields to generate cash quickly.

In contrast, the typical strategy for a pan-European point-to-point carrier may have consisted of embarking on an aggressive strategy in order to gain market share from Málev and employing competitive pricing to push up load factors, as passengers, in the context of the Euro crisis, became increasingly price sensitive.

But with legacy costs being heavy, fixed and not very flexible, there are limits to what could Malév to maintain market share and survive given its debt burden and the competition it Malév's bankruptcy raises the question of whether the collapse of this traditional network benefits for consumers in terms of price, frequencies, connectivity and quality of service, with Hungarian market forecast to be at least 53% in 2019 (refer to

Figure 12 above)

To understand and assess the consequences of Malév's collapse on consumers, we will investigate and review trends in fares and capacity both prior to and subsequent to the demise of Malév.

3.2. Data sources and limitations

This report has been prepared using data from two key sources:

a. Milanamos Planet Optim Future: a comprehensive database that provides detailed origin-destination and segment data for passengers and revenues by airline, class of travel and point of sale on a monthly basis from 2002 to current. It also provides airline schedule, capacity, yield and itinerary information sourced from both airline and travel agent booking systems.

b. Research that we have carried out into the existing literature that is relevant to this report. In conducting the literature review, we focused on the identification of airline bankruptcy effects on price and capacity. A list of the literature we have reviewed is contained in the appendix.

There are some limitations that should be noted:

- We collected data from Milanamos PlanetOptim Future to look at the routes that Malév operated between 2007 and February 2012. Data was collected for each route and city pair, on a monthly basis, including the average fares and average level of capacity[51] that were offered on these routes before and after Malév's bankruptcy. We have used the aggregate and average number estimates of passengers, fares and capacity. Hence, we are not showing the breakdown (i.e. the decrease or increase in both capacity and fares for each airline operating on the selected routes), but rather the analysis stresses the trends observed (i.e. whether there were an increase or decrease in both fares and capacity subsequent to Malév's collapse).

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51 Capacity is measured as the number of seats offered by route and airline for a selected period on a monthly basis.

- The reported fares are the fare component that the passenger pays and do not include ancillary revenues collected by some airlines, particularly low cost carriers (i.e. additional fees for baggage, seat selection, speedy boarding, etc.). This is a result of the data provider's methodology for collecting fare information. This limit could be qualified by the fact that actual price is probably more relevant, in the context of this analysis, as our intention is to fully assess price variations and its impact on consumers.
- With regards to the literature review, it is worth stressing that the Borenstein and Rose study to which we refer here (among others) is essentially focused on all major U.S. airline bankruptcies since 1984. In the US it is more common for a company to go into Chapter 11 bankruptcy, which gives the airlines an opportunity to reorganize and emerge from bankruptcy.

The US/chapter 11 isn't directly comparable with the EU aviation market, however the purpose of the literature review was also to consider the methodologies applied to assess the effect of an airline bankruptcy on fares and capacity. The literature review will be detailed in the Annex.

4. Market analysis

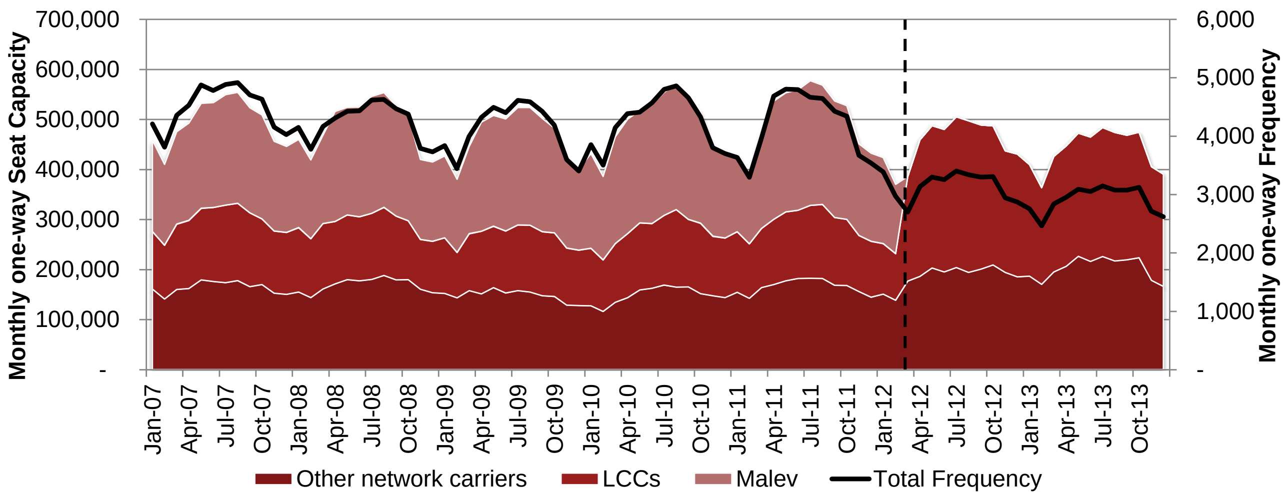
The impact on consumers as a result of Malév's collapse will be assessed through two key channels: 1) available capacity; and 2) air fares paid by the consumer.

4.1. Capacity

Capacity is measured based on scheduled available seats offered by airlines to and from Budapest airport.[52] Seat capacity is a function of both flight frequency and aircraft size, including aircraft type, aircraft seat configuration and seat density. The measure therefore captures changes of fleet composition and aircraft seat configuration of airlines operating in the Hungarian market as well as the frequency of flights they offer.

Figure 14 shows the available seat capacity offered from Budapest airport by carrier type. It clearly shows the impact of Malév exiting the market in February 2012 and the reaction of LCCs and other network carriers to the gap left by Malév. Whilst other network carriers increased capacity (by 12% over the period from July 2011 to July 2012), the increased capacity by LCCs (primarily Wizz Air and Ryanair) almost replaced the number of seats lost by Malév's exit (LCC capacity doubled over the period from July 2011 to July 2012).

Figure 14: Available monthly seat capacity and frequency from Budapest



Note: One-way scheduled seat capacity from Budapest

Source: Milanamos Planet Optim Future, PwC analysis

However, a decline in seat capacity was observed – 25% and 19% respectively for LCCs and other network carriers between July 2012 and December 2013. Indeed, the demise of Malév has led to a decrease in connectivity with the new entrants offering higher capacity and less frequent flights as depicted above. A fall in airline capacity may appear at first to negatively impact consumers, however the dynamic behind this drop in capacity is that the new entrants in the market are focusing essentially on profitable routes and exiting routes with insufficient demand. Airline operations are also optimised with an efficient fleet utilization, a

52 One limitation to note on using seat capacity to measure the impact of the collapse is that it will not take into account load factors and actual passenger demand.

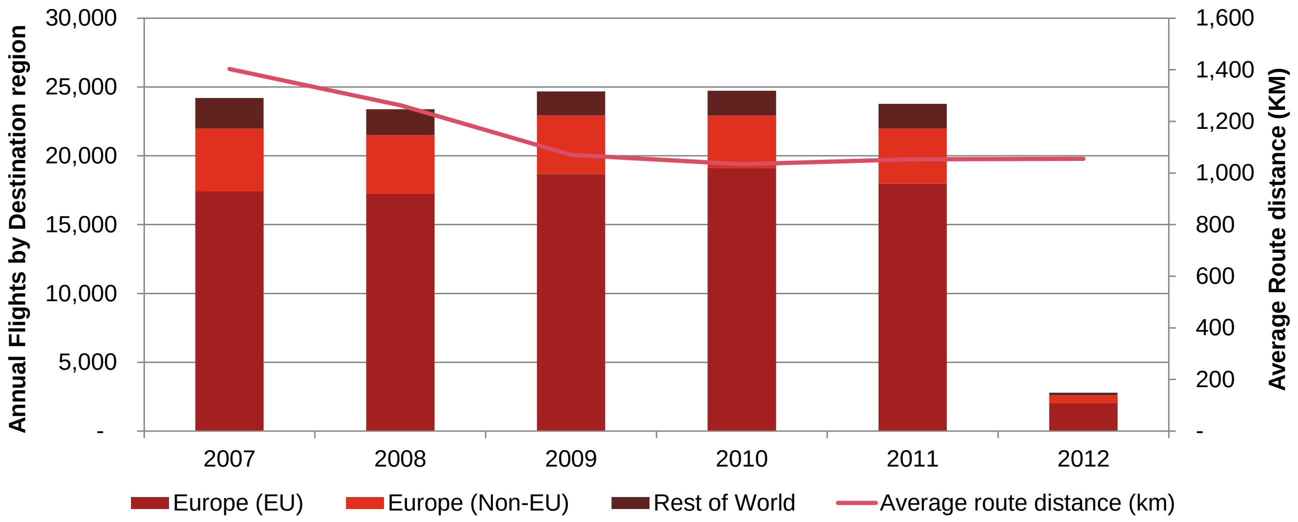
configuration of aircraft with higher seat density and strong load factors. This is discussed in further detail in Paper A.

4.1.1. Capacity offered by Malév

Prior to its collapse, Malév provided around 40 percent of the seat capacity at Budapest Airport. Malév's route network and fleet mix changed in the years leading to its collapse, reflective of the airline changing its strategy in an attempt to stabilise profitability.

Figure 15 shows the number of scheduled annual flights offered by Malév from Budapest airport by destination region. It shows that the vast majority of flights were within Europe (primarily within the EU). Non-European flights saw a small decline between 2008 and 2009 with the average route distance reflecting this. Capacity substantially dropped between 2011 and 2012 as depicted below.

Figure 15 – Malév's annual flights by destination region and average route distance



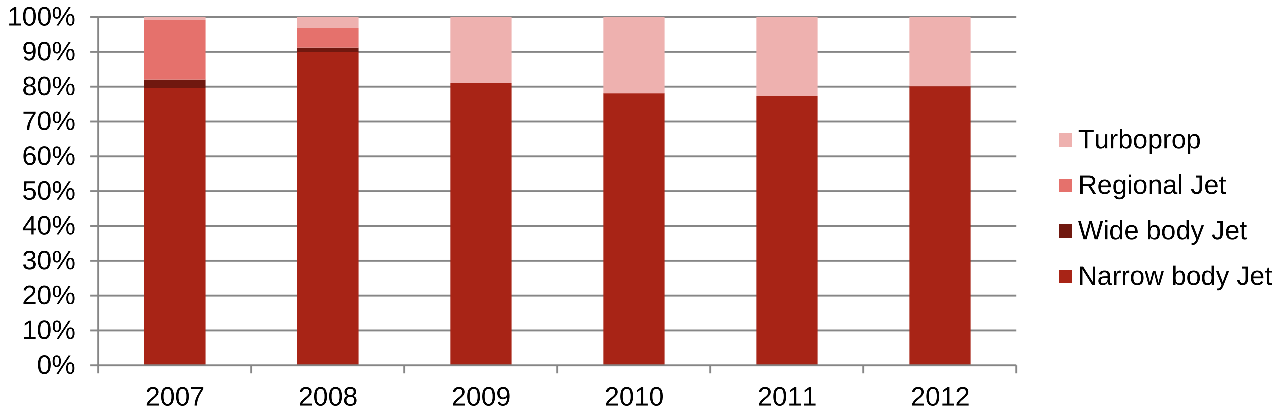
Note: EU includes current EU 28 countries across all years.

Source: Milanamos PlanetOptim Future, PwC analysis

Figure 16 shows the share of annual flights offered by Malév by aircraft type. In 2009, Malév launched a fleet simplification programme designed to simplify its fleet structure and associated cost – with the price of kerosene fluctuating unpredictably, airfares were also changing due to intense market competition in the context of the global economic crisis. This fleet rationalization occurred almost simultaneously with Malév dropping its long haul routes.

The core of Malév's fleet was made up of variants of the Boeing 737 narrow body jet. Malév phased out its wide body Boeing 767 aircraft in 2008 and in the same year introduced Bombardier Q400 turboprop aircraft to serve short-haul, regional routes. Regional jets were phased out by 2009.

Figure 16 – Malév's Share of Annual Flights by Aircraft type from Budapest Airport



Source: Milanamos Planet Optim Future, PwC analysis

The table below shows Malév's fleet at the time of ceasing operation.

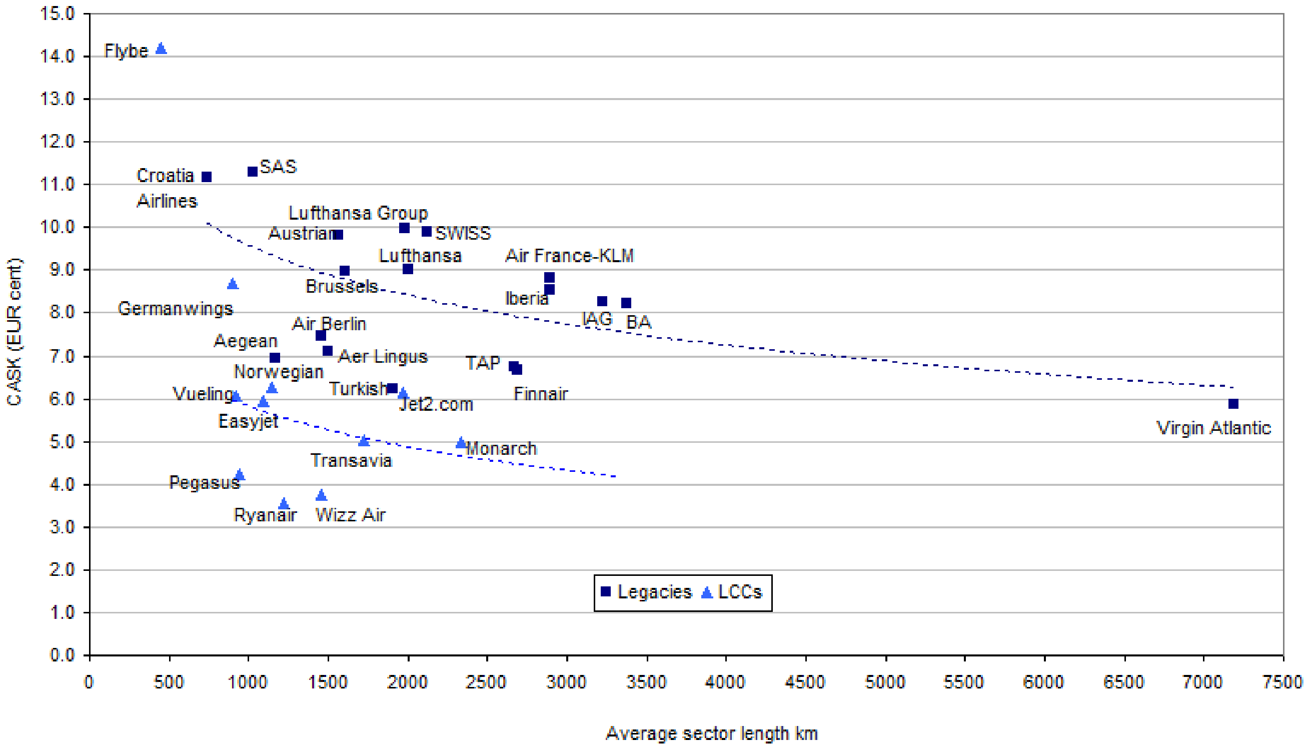
Table 8 – Malév's fleet composition as at February 2012

Aircraft Type	Number of units
Boeing 737-800 NG	5
Boeing 737-700 NG	7
Boeing 737-600 NG	6
Bombardier Q400	4
Total	**22**

Source: CAPA, PwC analysis

As a result of the fleet rationalisation, capacity offered by Malév dropped and it is likely that the only way for Malév to have increased capacity was by increasing the utilisation of its existing fleet. Fleet changes, coupled with network changes, led to a decline in available seat kilometres offered by the airline in the years leading to its demise. Clearly the fleet rationalisation was expected to significantly reduce Malév's fixed cost. But when referring to the below figure (Figure 17), it is not unreasonable to say that Malév struggled to achieve a lower or nearly equal CASK per sector length than the strong LCCs, Wizz Air and Ryanair; which would have given Malév a strong competitive advantage.

Figure 17: Unit costs and sector length for selected EU carriers, 2012



Source: CAPA analysis of airline company traffic and financial statements and press releases[53]

4.1.2. Capacity offered by other airlines

Other network carriers

At the time of the Malév collapse, around 30 other network carriers offered services from Budapest Airport. While the number of carriers hasn't substantially changed, these carriers increased capacity from the airport following the exit of Malév (as observed in .

Figure 11 with capacity increases). Following the collapse, some routes were left unserved, while many were left with only one carrier (this is discussed further in Section 1 of Paper B). In response to the gap left by Malév, some existing network carriers increased capacity (e.g. Lufthansa, Turkish) while a few others (e.g. Aegean, Bulgaria Air) entered the market.

Low Cost Carriers

The dominant LCCs operating in the Hungarian market are local airline Wizz Air, Ryanair (since the demise of Malév) and easyJet. As seen in Figure 14, LCCs increased capacity substantially in response and shortly after Malév's collapse. However, it is important to stress that with time capacity appears to be more controlled, with airlines focusing on routes that have strong demand.

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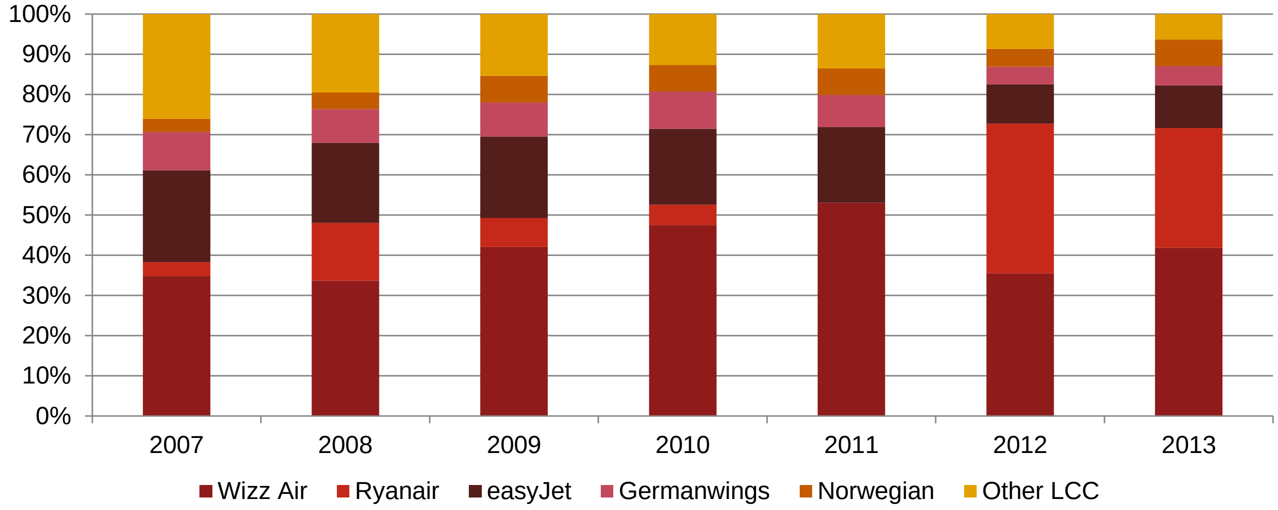
53 *Financial year ends as follows: Croatia Airlines, Jet2.com, Ryanair Mar-2013; TAP Portugal, Brussels Airlines, Pegasus Airlines, Air Berlin, Turkish Airlines, Lufthansa, Aer Lingus, IAG, Iberia, BA, Air France-KLM, Finnair, Norwegian, Vueling Dec-2012; Monarch, SAS Oct-2012; easyJet Sep-2012; Wizz Air, Mar-2012, Virgin Atlantic Feb-2012.*

Figure 18 – Share of LCC seat capacity from Budapest Airport by Airline



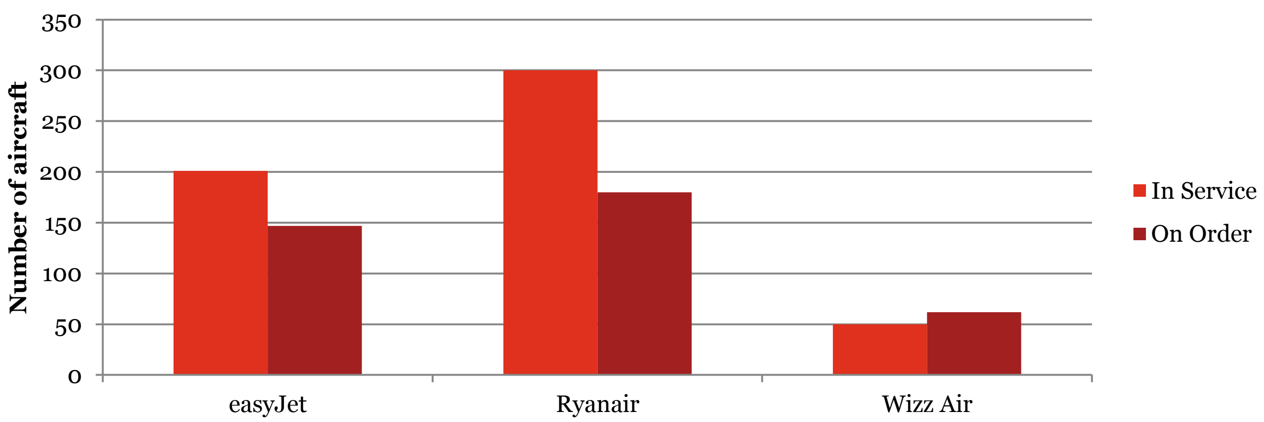
Source: Milanamos Planet Optim Future, PwC analysis

Ryanair re-entered the market in Budapest following the collapse of Malév. The airline had previously been serving several routes from the airport before withdrawing in 2010 following a dispute with Budapest Airport management over fees. The collapse of Malév put Budapest Airport in a much weaker negotiating position with Ryanair, with the airline proceeding to operate around 30 routes from March 2012 for the remainder of that year (this dropped to around 20 in 2013) filling much of the gap left by Malév's exit.

Amongst the low cost sector Ryanair and Wizz Air are the two most prolific carriers in 2013, having expanded their capacity offer rapidly, and now control over 60% of the low-cost carrier market.

Furthermore, aircraft fleets and fleet planning is a reliable indicator of airline strategy. As the chart below indicates Wizz Air aircraft orders exceed current fleet size at 124% of its total fleet in service (with 60% and 73% respectively for Ryanair and EasyJet). It is important to keep in mind that these carriers, particularly easyJet and Ryanair, are Pan-European multi-nationals and aircraft orders do not indicate the locations that additional aircraft would be deployed within Europe. Nonetheless, it is an indicator overall that these carriers are financially stable and expecting to expand their operations in the future. It is not unreasonable to assume that some proportion of this expansion would continue to be in the CESE region and hence in Hungary.

Figure 19 – Selected LCC fleet orders as proportion of existing fleet, 2014



Source: Centre for Aviation Fleet database as of June 2014

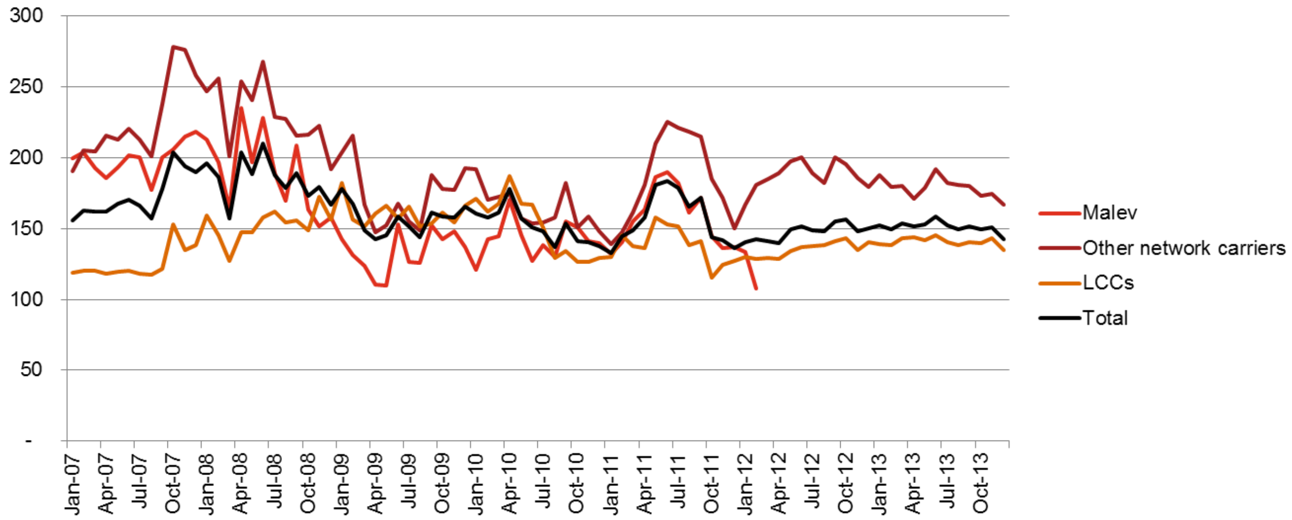
4.2. Fares

The analysis also considers how the exit of Malév has impacted on air fares paid by consumers. Key drivers of average fares include level of demand, strength of the economy and associated disposable income, competition, route segment and route distance as well as carrier type. Increased competitive intensity, in the context of a weak global economy, shorter route segments and increased LCC penetration (e.g. LCCs have a lower cost base and as such can provide competitive fares) leads to a decrease in fares. This is reflected in the general downward trend in fares observed in Figure 20. Given these factors, along with the change in mix of routes and airlines, both prior to and following the Malév collapse, it is difficult to isolate the impact of the exit of Malév and draw conclusions based on average monthly fares.

It is also worth mentioning that the fare data only accounts for the fare revenue component that the airline collects; thus for airlines such as LCCs who unbundle fares and collect ancillary revenues for extras such as seat selection and hold baggage, the total fare will not be fully captured. For the most part, these extra charges are included in the fare component for network carriers.

A notable observation from Figure 20 is that the average fare is much less seasonal following the collapse of Malév. This is a result of the market being dominated by LCCs, primarily the competition between Wizz Air and Ryanair and the yield management strategies of these airlines.

Figure 20 – Average one-way fares from Budapest



Note: Average segment fares (O&D passengers only) from Budapest, weighted by passenger number. The data includes non-continuous and continuous routes.

Source: Milanamos Planet Optim Future, PwC analysis

Malév's bankruptcy and subsequent exit may have led to an immediate increase in fares, potentially as a result of Malév having originally cut prices before its collapse in order generate revenue. Thus, once it had exited the market, routes which were now operated by competitors would have seen an increase in price – however, in reality fares were simply returning to their original level, i.e.:

- a market fare level resulting from demand and supply equilibrium;
- a market fare level that meets the current level of purchasing power in the country; or
- a market fare level allowing airlines to cover fixed costs and generate a margin.

It is also possible that, as a result of Malév's collapse, airlines seized the opportunity to enter the market because of the gap Malév left and the financial distress this has caused Budapest Airport. These airlines would become "price maker" as consumers have no other choice but to fly with a LCC.

In general, LCCs would offer an appealing price/ticket fare. A European Flight Index study by kelkoo (2011),[54] investigated the relative benefits of European LCCs compared with European full service carriers. The study compared 5,000 airfares from 20 different airlines at 192 airports.

Key findings include:

- LCCs offer fare savings of 33% on average fares compared with full service counterparts, increasing to 39% cheaper if purchased up to nine weeks in advance;
- LCC fares are on average 41% cheaper on international flights and 20% on domestic flights compared with full service airlines;
- Fare difference between budget and conventional airlines can vary by as much as 56% if additional charges are not taken into account;
- On average, 37% of the total LCC fare is accounted for by ancillary revenues and extra charges, compared to 4% of the average full service carrier fare;
- Highest amount of extras are levied in Italy (45%) and the UK (38%), and the lowest in Spain (32%) and Germany (31%);
- German, Italian and French fares offer the greatest difference between LCCs and full-service carriers.

4.3. Findings of market analysis

It appears from the aggregate time series analysis shown in sections 2.1 and 2.2 that the Malév collapse led to a decline in seat capacity and a marginal increase in air fares. However, it is difficult to quantify the impact and draw conclusions from such aggregated information given the large number of factors at play determining capacity and fares.

It is therefore necessary to conduct econometric analysis to assess the impact at a more granular level and capture some of the additional factors such as route network, level of competition and external influences on the market (e.g. income levels and fuel prices). The econometric analysis will provide some evidence on whether capacity and fares changed following the Malév collapse rather than as a result of the collapse. There may be other factors that cannot be captured through econometric analysis – such as airline strategy. It is therefore important to consider this in interpreting the results of the analysis.

54 See breakingtravelnews.com, 18-Apr-2011

5. Econometric analysis

5.1. Impact of Malév's bankruptcy on average fares and capacity

Econometric analysis was undertaken to assess the effects of Malév Hungarian Airlines' bankruptcy in February 2012 on two aspects of the Hungarian airline market's performance:

Hypothesis:

a. Fares: Malév's bankruptcy has the potential to reduce competition in the market, which in turn could lead to an **increase in fares**; and

b. Capacity: Malév's bankruptcy has the potential to **lower levels of capacity**, resulting in a **reduction in connectivity**.

To understand the true impact of Malév's bankruptcy on average fares and capacity, it is important to distinguish between the effects of adverse economic shocks on the airline market and the causal consequences of airline bankruptcy. Econometric techniques are better than the more basic techniques such as comparisons between the 'before' and 'after' data as econometric analysis can isolate the statistical relationship between the dependent variable (i.e. one of the aspects of market performance) and the key variable of interest (i.e. a dummy variable[55] indicates the period after Malév's bankruptcy in February 2012). That is, econometric techniques can control for other factors that have the potential to impact the dependent variable (e.g. prices, number of airlines servicing a particular route etc.).

A separate econometric model has been constructed for each of the two aspects of market performance described above because each aspect has its own set of statistical issues (completeness of data, model dynamics)[56]. The key results from the econometric analysis are summarized below. Please refer to the Annex for a more detailed discussion on the methodology, rationale and results.

5.1.1. High level methodology

Econometric analysis was carried out to understand the impacts Malév's bankruptcy on average aviation fares and capacity in the Hungarian airline market. Two approaches were used to estimate the impact of Malév's bankruptcy on average aviation fares: i) dummy variable approach, and ii) synthetic control method. For estimating the impact of Malév's bankruptcy on capacity, only the dummy variable approach was used.

Dummy Variable Approach: The econometric analysis using the dummy variable approach was carried out on a panel dataset that contains monthly time series on route data from January 2007 to December 2013. The dataset includes 33 destinations served from Budapest that Malév operated on before its collapse, for a total of 65 routes in account for both inbound and outbound journey.

To estimate the impacts of Malév's bankruptcy on average aviation fares and capacity in the Hungarian aviation market, several econometric estimation methodologies, such as the Fixed Effects (FE), Random Effects (RE), Weighted Fixed Effects (weighted FE), and Fixed Effects Instrumental Variable (FE IV), were used . These are explained in more detail in Section 1.3 in the Annex. The basic modelling approach is to construct a regression model that tests the link between average airfares across the routes that Malév operated on and then test the significance of a dummy variable that marks the dates after Malév's bankruptcy.

55 In statistics and econometrics, particularly in regression analysis, a dummy variable is a variable that takes the value zero or one to indicate the absence or presence of some categorical effect that may be expected to shift the outcome.

56 A combined analysis of each of the three aspects would be highly complex and suitable data are not available.

It should be noted that the dummy variable approach only considers the routes on which Malév operated. Ideally, a difference-in-difference (DiD) method which compares routes where Malév had and had not operated on would be used to estimate the impact of Malév's bankruptcy. However, this technique imposes many important assumptions on the data, some of which cannot be met in this case. For example, it requires the routes where Malév did not operate on to be exactly identical to the routes where Malév operated on prior to its bankruptcy. Therefore an alternative approach known as the "Synthetic Control Method" was proposed.

Synthetic Control Method: The Synthetic Control Method aims to explain the impact of Malév's bankruptcy by constructing a "synthetic" route (i.e. the control route) which is comparable to the "average route" on which Malév operated on (i.e. the treated route). Thus, any difference between the routes following the collapse is then attributed to the Malév bankruptcy. This approach allows us to consider a more comprehensive set of routes than the dummy variable approach.

A more detailed discussion of the methodology of these approaches and the rationale for choosing them are presented in the Annex. The results of the analyses are described below.

5.1.2. Impacts on fares

A dummy variable approach was used to estimate the effect of Malév's bankruptcy on the average fares in the Hungarian aviation market. An econometric estimation technique known as the panel instrumental variable fixed effects model was used to do this. *The key results from our econometric analysis suggests that Malév's bankruptcy is associated with a decrease, between 8.0 and 8.6 percent, in average fares across all routes that Malév served prior to its bankruptcy. However, the actual impact may be smaller in magnitude as the fares data used in the econometrics analysis do not include ancillary charges.*

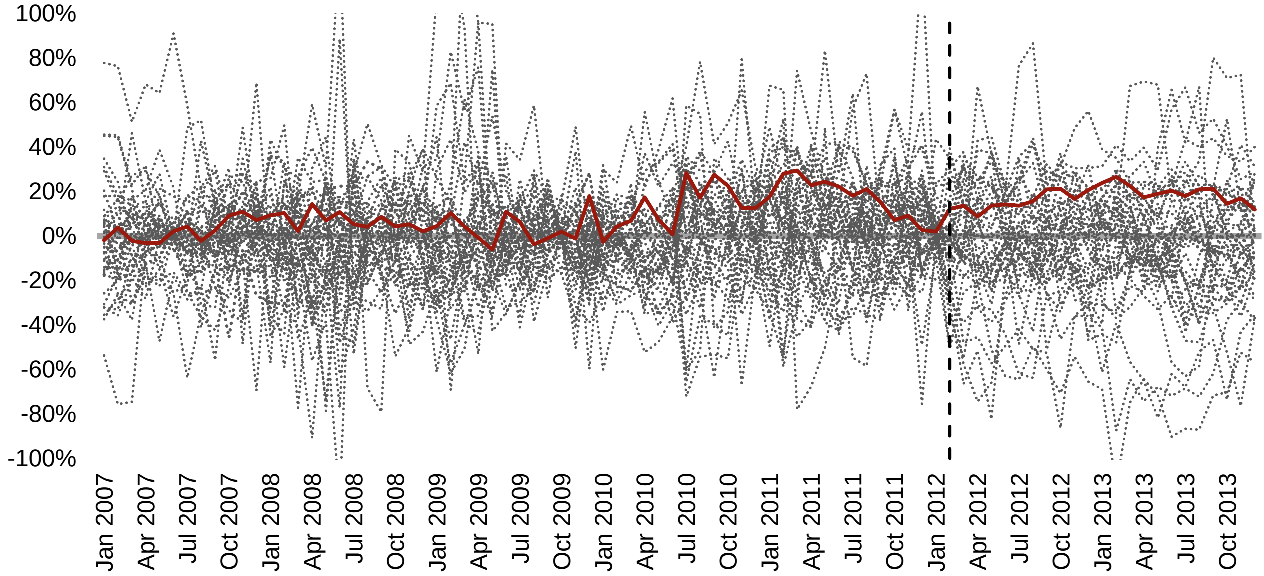
As described above, the Synthetic Control Method was also used to estimate the effects of Malév's bankruptcy on average aviation fares of routes originating from Budapest. *The Synthetic Control Method approach suggests that the collapse of Malév in February 2012 has led average fares to increase between 10 to 20 percent when compared with the counterfactual scenario where Malév did not go bankrupt. However, subsequent statistical tests suggest that these results cannot be relied upon as discussed below.*

The results of the Synthetic Control Method should be interpreted with care. Following Abadie *et al.* (2010)[57], the significance of the estimates of the impact of Malév's bankruptcy on fares are evaluated by considering "whether the results obtained could be driven entirely by chance". The results of the placebo tests are presented in Figure 21. The solid red line denotes the percentage difference between the fares of the actual and synthetic Budapest route. The grey lines denote the percentage difference between the fares for each individual route between the actual and synthetic cases respectively. The placebo tests conducted are not conclusive about whether this effect is significant or whether it is caused by other random shocks. Figure 21 shows a few individual routes, which were not affected by Malév's bankruptcy, demonstrating a similar uplift in prices after February 2012 (i.e. grey lines above the red lines).

Because of the limitations of the data used to implement the synthetic control group method - , the result is likely to be unreliable. Therefore, the result from the dummy variable approach, which suggests that Malév's bankruptcy is associated with a 8.0-8.6 percent decrease in average fares across all routes that Malév served prior to its bankruptcy, is preferred.

57 Abadie, A., Diamond, A. and Hainmueller, J. (2009). *Synthetic control methods for comparative case studies: estimating the effect of California's tobacco control programme*. Journal of the American Statistical Association, Vol. 105, No. 490, Application and Case Studies.

Figure 21 – Placebo test comparing Budapest treatment effect with other individual synthetic control routes



Source: PwC analysis

5.1.3. Impacts on capacity

To understand the impact of Malév's bankruptcy on capacity, an econometric modelling technique known as the panel instrumental variable fixed effects model was used. The key results of the econometric analysis suggests that Malév's bankruptcy led to a 6.3 percent decline in capacity for the average route that Malév has operated in prior to its bankruptcy.

5.2. Estimation of historical income and price elasticity

In addition to estimating Malév's bankruptcy on average fares and capacity, PwC was also asked to estimate the historical income and price elasticities of Malév as part of the econometric analysis. Income and price elasticities are measures used in economics to indicate the responsiveness of the quantity demanded of a good or service to a change in consumers' income or price respectively.

The "Almost Ideal Demand System" (AIDS) approach is used to estimate the historical income and price elasticities of Malév. The key result suggests that historically, if consumers' incomes are increased by 1 percent, consumers' expenditure on Malév increased by approximately 1.2 - 1.6 percent for the three routes. The model also shows that historically, a 1 percent increase in the price of Malév fares led to an approximate 0.44 - 0.48 percent decrease in consumer expenditure on Malév for the three routes that were modelled.

These are relatively high income and price elasticity for the three routes when compared with other airlines in the routes that were included in the model.

5.3. Summary conclusions

Our analysis of the market in Chapter 2 of this report has suggested that the Malév collapse has likely led to a decline in seat capacity and a slight increase in air fares, alongside rationalising of the number of routes operated. Acknowledging that these outcomes are also influenced by other factors such as wider economic conditions, we have employed the econometric analysis techniques as described above to isolate the impact of Malév's collapse on fares and on capacity.

The econometric techniques utilised to assess the impact of Malév's bankruptcy on airfares and capacity provides the following findings:

- Between 8.0 and 8.6 percent decline in average fares across all routes that Malév served prior to its bankruptcy, but as discussed in Section 3, the true effect may be smaller than this as the fares data used in the econometric analysis does not include ancillary charges; and
- A 6.3 percent decline in capacity for the average route that Malév has operated in prior to its bankruptcy.

While the market analysis suggests a slight increase in fares, the econometric analysis demonstrates a trend towards a decrease in fares.

It should be noted also that the econometric results - apply to average airfares and routes, and does not imply that a uniform effect was noted across all fares and all routes. In addition, it should also be stressed that actual outcomes are also influenced by a range of other important market conditions. Therefore, this analysis describes the specific case of Malév’s collapse in Hungary, and is not necessarily indicative of the impact that might occur in other airline bankruptcy cases.

Appendices

Appendix A – Econometric analysis of the Malév bankruptcy

A1.1 Introduction

Many airlines operating in the Baltic States, Central, Eastern and South-East Europe ('CESE') are financially very fragile due to record high fuel prices, inflexible labour cost and stringent regulatory rules such as State Aid restrictions. As airlines adopt more restrictive capacity management strategies in response to these challenges, there is a potential that this will lead to a decline in capacity and connectivity, and an increase in aviation fares, which are all to the detriment to consumers.

However, some argue that impacts of bankruptcy of flag carriers on average fares and capacity will be minimal. To shed light on this debate, econometric analysis was undertaken to assess the effects of Malév Hungarian Airlines' bankruptcy in February 2012 on two aspects of the Hungarian airline market's performance:

- **Fares:** Malév's bankruptcy has the potential to reduce competition in the market, which in turn could lead to an **increase in fares;** and
- **Capacity:** Malév's bankruptcy has the potential **to lower levels of capacity**, resulting in a **reduction in connectivity.**

To understand the true impact of Malév's bankruptcy on average fares and capacity, it is important to distinguish between the effects of adverse economic shocks on the airline market and the causal consequences of airline bankruptcy. Econometric techniques are better than the more basic techniques such as comparisons between the 'before' and 'after' data as econometric analysis can isolate the statistical relationship between the dependent variable (i.e. one of the aspects of market performance) and the key variable of interest (i.e. a dummy variable[58] that indicates the period after Malév's bankruptcy in February 2012). That is, econometric techniques can control for other factors that have the potential to impact the dependent variable (e.g. prices, number of airlines servicing a particular route etc.).

A separate econometric model has been constructed for the two aspects of market performance described above because each aspect has its own set of statistical issues (completeness of data, model dynamics)[59].

A1.1.1 Impact on fares

Econometric analysis was carried out to understand the impacts of Malév's bankruptcy in February 2012 on average aviation fares in the Hungarian airline market. Two approaches were used to do this: i) dummy variable approach, and ii) synthetic control method.

The econometric analysis using the dummy variable approach and the synthetic control methods was carried out on a panel dataset that contains monthly time series on route data from January 2007 to December 2013. The dataset includes 33 destinations served from Budapest that Malév operated on before its collapse, for a total of 65 routes in account for both inbound and outbound journey.

Various econometric modelling methodologies, such as the Fixed Effects (FE), Random Effects (RE), Weighted Fixed Effects (weighted FE), and Fixed Effects Instrumental Variable (FE IV), were used to estimate the impacts of the Malév bankruptcy on the average fare of a route. These are explained in more detail in Section

58 In statistics and econometrics, particularly in regression analysis, a dummy variable is a variable that takes the value zero or one to indicate the absence or presence of some categorical effect that may be expected to shift the outcome.

59 A combined analysis of each of the three aspects would be highly complex and suitable data are not available.

1.3. The basic modelling approach is to construct a regression model that tests the link between average airfares across the routes that Malév operated on and then test the significance of a dummy variable that marks the dates after Malév's bankruptcy in February 2012.

A more detailed discussion of the methodology of these approaches and the rationale for choosing them are presented in Sections 1.2 and 1.3.

Key results of impacts on fares using the dummy variable approach

- The key result of the econometric analysis suggests that the collapse of Malév is associated with a 8.0 to 8.6% decline in average fares across all routes that Malév served prior to its bankruptcy.
- However, the true impact of Malév's bankruptcy on average aviation fares may be smaller in magnitude, as the fares data used for this analysis do not include ancillary charges.

An alternative estimation approach, known as the 'Synthetic Control Method', was also used to estimate the effects of Malév's bankruptcy on average aviation fares of routes originating from Budapest. This was done by comparing the fares of the 'average route' that Malév operated on (i.e. this is simply the average of all the Malév routes in the dataset) with a 'synthetically constructed' control group. The synthetically constructed control group is a comparative control group that resembles the average Malév route before the collapse of Malév (i.e. it is the counterfactual case of what would happen to fares to the average routes originating from Budapest if *Malév had not gone bankrupt*). The rationale for synthetically constructing a control group in such a way is so that like-for-like comparisons could be made with the actual average Malév route.

The synthetic control group is constructed using data on routes where Malév's bankruptcy is not expected to have a significant impact on (i.e. routes that originate from airports outside of Hungary), and it is constructed in such a way that its average fare aligns with the fare of the average route that Malév operated on prior to its collapse. Another way of viewing the synthetic control group is that it is a hypothetical route in the counterfactual scenario where Malév did not go bankrupt.

Key results of impacts on fares using the Synthetic Control Method

- After Malév's bankruptcy in February 2012, the average fare on routes originating from Budapest was 10- 20% above its comparators. However, this result is statistically insignificant.
- The results are unreliable as there are not enough good explanatory variables to construct a synthetic control group which mimics the average fare of routes originating from Budapest over the period between January 2007 and January 2012. As a consequence, it is difficult to isolate the true effects of the bankruptcy of Malév (if any) from other factors and random shocks. In addition, the model suffers from potential omitted variable bias, as key variables such as capacity are excluded from the model.

A1.1.2 Impact on capacity

Econometric analysis was also carried out to understand the impact of Malév's bankruptcy on capacity. The data used for the fares analysis is also used here. As with the fares analysis, the FE, RE, weighted FE and FE IV econometric modelling approaches were used to estimate the impacts of the Malév bankruptcy on capacity.

Key results of impacts on capacity

- The econometric analysis suggests that for the average route that Malév has operated in prior to its bankruptcy, the Malév bankruptcy is attributable to a 6.3% decline in capacity.

The econometric analysis confirms that Malév's bankruptcy has led to a decrease in capacity, and therefore connectivity, in the Hungarian aviation market.

A1.1.3 Structure of this paper

The remainder of this paper is devoted to a more detailed discussion of the econometric results and existing evidence and is structured as follows:

- **Section 1.2** discusses previous studies by academics that have used econometric techniques to examine the effects of airline bankruptcy.
- **Section 1.3** describes the econometric methodology and techniques used to understand the effects on average fares due to the collapse of Malév.
- **Section 1.4** documents the data that is used in the econometric analysis, and the data cleaning processes undertaken to prepare the data for this exercise.
- **Section 1.5** reports the results from the fares econometric analysis.
- **Section 1.6** reports the results from the capacity econometric analysis.

A1.2 Literature review

A review of existing academic literature has highlighted several studies that empirically estimate the impact of bankruptcy on prices in the aviation sector, but few estimate the impact on capacity.

Borenstein and Rose (1995)[60] considered data on four US airline bankruptcies in the late-1980s and early-1990s to empirically estimate their effects on airline price. They modelled the quarter-to-quarter change in log price for an airline on a route as a function of current and one-period-lagged changes in the passenger-based Herfindahl Index[61] (to control for changes in market structure), lagged changes in the log-price variable (to control for the substantial negative serial correlation in price changes), time-fixed effects for each quarter and a set of bankruptcy measures.

Their model implicitly assumed that exogenous changes in the remaining variables typically included in cross-sectional models of airline price levels, such as airport congestion, market density, network interconnectedness and airport dominance are sufficiently small that they can be excluded from the specification.

They also included two sets of indicator variables designed to capture the effects of impending or recently declared bankruptcy on route prices; the first set measures the average change in price for a bankrupt airline, while the second measure the average change in price for non-bankrupt airlines on routes with a near-bankrupt or bankrupt competitor. The model is estimated using unweighted ordinary least squares (OLS) with time-fixed effects.

The net change in prices over the year-long window around the bankruptcy announcements is –5.5% for the bankrupt carrier and +1.1% for its competitors.

In a similar study, Huschelrath and Muller (2012)[62] estimate the effect of five liquidations and six mergers on prices in the domestic U.S. airline industry between 1995 and 2010. They used a FE regression model to estimate the short, medium and long-run effects of firm exit on average market yields, departures and passengers. Using a step-wise approach, they were able to isolate the short-term and the long-term impacts and also the entry-inducing effects following the exit of a firm.

Unlike the Borenstein and Rose study, this study uses a number of control variables. These include the number of carriers, the number of low cost carriers, the average size of planes, airport size, the price for one-stop flights on the same route and macroeconomic variables such as labour force size.

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60 Borenstein, S., and Rose, N. (1995). *Do airlines in chapter 11 harm their rivals? Bankruptcy and pricing behavior in US airline markets*. No. w5047. National Bureau of Economic Research, 1995

61 The Herfindahl Index (also known as the Herfindahl Hirschman Index or HHI) is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them and is defined as the sum of the squares of the markets shares of the 50 largest firms within the industry.

62 Huschelrath, K. and Muller, K. (2012). *The competitive effects of Firm Exit- Evidence from the U.S. airline industry*. Discussion Paper no. 12-037. Centre for European Economic Research

They find that merger-induced exits from routes leads to a smaller increase in price compared to liquidation-related exits. However, the merger efficiencies and entry-inducing effects are strong enough to drive prices down to pre-exit levels in the long run.

Busse (2002)[63], in his study of airline price wars during bankruptcies, uses two different models; one to estimate the probability of starting a price war, whilst the second estimates the probability of participating in price wars. Both behaviours are explained using measures of demand, financial health and controls for time and size of the firm. Demand, as measured by the number of passengers, is endogenous with the likelihood of a price war, and is instrumented using three macroeconomic variables (unemployment, output and income). A FE model is used to control for time and size-specific effects. A probit modelling approach is used to estimate the probability of initiating and participating in price wars. Busse finds that airlines in a bad financial situation are more likely to start price wars. He also finds that a firm is more likely to enter a price war the greater the share of its traffic on routes shared by the leader.

Neither the Borenstein and Rose paper, the Huschelrath and Muller paper nor the Busse study consider the effects on capacity. However, Ciliberto and Schenone (2010)[64] have also investigated the effect of bankruptcy on prices, capacity choices, and networks. The Ciliberto and Schenone study differs from the Borenstein and Rose approach on three points:

- The Ciliberto and Schenone study considers multiple strategic decisions (network structure, capacity choices and prices);
- Unlike the Borenstein and Rose study, it looks at the impact on prices during and after bankruptcy filing; and
- Ciliberto and Schenone include specifications that control for such unobserved heterogeneity using route-carrier FE, since it is likely that there are heterogeneous route-carrier unobservables that might confound the results in Borenstein and Rose.

The study does not explicitly include demand and supply (capacity) related variables due to endogeneity and the lack of quantifiable or observable data. However, they construct a set of bankruptcy categorical variables that capture these effects.

There are three types of explanatory variables used in the model. Firstly, the study includes linear market time trends to control for such market-specific unobservable correlations across time. Secondly, there are two sources of FE included in the model. To control for serially correlated industry-specific shocks, they include year-quarter FE. Some carriers which fly specific routes at certain times may benefit from business travel while others may not. FE is also used to account for these route-specific effects. Finally, following existing literature, the standard errors are clustered by various measures depending on the unit of observation.

This study also identifies that the effects on prices may be muted by the 'Ashenfelter dip'[65] phenomenon. To account for this phenomenon, the observations corresponding to two quarters prior to the to-be-bankrupt firms' bankruptcy filing date and corresponding to markets where this firm was present were dropped.

This study finds that the bankrupt carrier permanently drops 25% of its pre-bankruptcy routes. The bankrupt carrier also reduces it average number of markets out of an airport by 26%. They find that the insolvent carrier's price drops by 3.1% while under bankruptcy protection and increases by almost 5% after emerging from bankruptcy proceedings. However, there was no evidence of any significant changes or effects on competitors.

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63 Busse , M. (2002). Firm financial condition and airline price wars. RAND Journal of Economics Vol 33 No. 2

64 Ciliberto, F., and Schenone, C. (2010). A*re the bankrupt skies the friendliest?*. MRPA paper no. 24915, 2010

65 Airline prices may fall in the quarter before the bankruptcy filing, thereby dampening the impact on prices before, during and after the bankruptcy filing. This phenomenon was first identified in Ashenfelter (1978) in a study of the effect of training programmes on earnings.

The bankrupt carrier also reduces the frequency of flights by 21% during proceedings and by 32.8% after proceedings. The study did not find robust evidence of significant changes in the competitors' behaviours.

Based on studies above, we apply an FE modelling approach to estimate the effects of the Malév bankruptcy in February 2012 on the Hungarian airline market's performance in terms of fares and capacity. However, it is recognised that the standard FE approach may not serve as the best tool for correcting for unobserved effects, so we consider alternative methodologies to deal with this. The variables in this study, i.e. bankruptcy, seat capacity, bilateral agreements, the presence of low cost carriers, etc., are similar to the variables used in the studies above. Where possible, direct instruments are preferred over categorical variables so that demand and supply factors are accounted for. These variables are discussed in greater detail in Section 1.4 below.

A1.3 Econometric methodology

The purpose of this paper is to examine the impact of Malév's bankruptcy on fares and capacity in the Hungarian aviation market. A separate econometric model is constructed to analyse each aspect of market performance, and in the following sections, each model is discussed in turn. Key findings drawn from the literature review in Section 1.2 are used to inform the choice of econometric modelling techniques used for this piece of econometric analysis.

A1.3.1 Fares model

A1.3.1.1 Core model (Fixed effects)

The central hypothesis behind the fares model is that Malév's bankruptcy has reduced competition in the Hungarian airline market and driven up prices. The basic modelling approach is to construct a regression that tests the link between average airfares across routes that Malév operated on and then test the significance of a dummy variable that mark the time periods after Malév's bankruptcy in February 2012. The regression is structured as follows:

$$\log avgfare_{it} = \alpha_i + \sum_t \gamma_t \cdot D_t + \delta_j X_{it} + e_{it}, \qquad \textit{(Equation 1)}$$

Where:

- $avgfare_{it}$ is the average fare of route i in time period t. This is the model's dependent variable;
- α_i is the constant term;
- D_t is a dummy variable which takes the value zero for the periods where Malév was still operating and one for the periods after Malév's collapse in February 2012. This is the main variable of interest, and the estimated value of the coefficient γt provides insights regarding the effects of the Malév collapse on the average fares that consumers have to pay. Note that there is no subscript i for this variable. This is because the bankruptcy dummy variable is not route specific, i.e. Malév is bankrupt after February 2012 regardless of the choice of route;
- X_{it} is a matrix of control variables – these include dummies that indicate presence of other flag carriers, or the presence of LCCs in route i at time t; and
- e_{it} is the model error term.

A key issue with a route based analysis is that each individual route will have some time invariant route specific fixed effects. In practical terms this means that there are unobserved factors at play that can also explain the observed differences between the averages fares of each route (e.g. some routes may be more popular than others). These unobserved factors are assumed to be time invariant – i.e. a popular route to a favoured holiday or business destination would remain popular over the time period for which the regression is estimated. Failing to account for these unobserved factors may lead to results that are biased and misleading.

To correct for these unobserved factors, an econometric technique known as the FE model is applied. The central principle behind the FE approach is the assumption that there are some factors at the route level that may bias the dependent variable (average fares) that the model is trying to predict. In technical terms, this bias comes from a correlation between the error term in the regression and the predictor variables. For example, factors such as popularity of a route which are unobservable to the econometrician will be captured in the error term.

The popularity of the route will be correlated with predictor variables such as the dummy variables indicating whether there are any other flag carriers and/or LCCs compete with Malév on the route for passengers (e.g. the more popular the route, the more likely that other flag carriers and/or LCCs will also serve that route to meet demand), thus leading to a correlation between the error term and the predictor variables (as route popularity is captured in the error term). Failing to control for such unobservable route specific factors can cause serious challenges in identifying relationships in the data. The FE modelling approach removes the time-invariant characteristics from the predictor variables so that the predictors' net effect on average fares can be assessed.

However, the standard FE model may not serve as the best tool for correcting for unobserved effects. In the subsections below, four alternative estimation strategies can be implemented as extensions to the standard FE model described above:

- the random effects method;
- the weighted fixed effects method;
- the instrumental variables method; and
- the synthetic control method.

A1.3.1.2 The Random effects method

An alternative to the FE model is the RE model. The RE model still accounts for unobserved differences between routes, but it assumes that the unobserved differences are **not correlated** with the predictor variables.

This could occur if the dataset is a purely random selection of routes from the total population of routes to and from Budapest. If this is indeed the case, then there is a 'random' component in the model that captures the difference between the average fare of route i and the average fare of the entire population of routes to and from Budapest. The effect is 'random' and is not correlated with the predictor variables because the route has been randomly selected from a larger population of schools.

Although the dataset used for this econometric study (which comprises of only routes to and from Budapest and is operated by Malév) is not a random sample from the total population of routes that begin or end in Budapest, it is important to test for the possibility that the dataset resembles a random sample. This test is undertaken by constructing both a FE and a RE fares model and then using a statistical test known as the Hausman test to check whether the unobserved variables are correlated with the predictor variables (if so, use the FE model) or not (then use the RE model). If this pattern of correlation is unknown it is not possible to say whether the FE or RE estimation process should be used.

A1.3.1.3 The weighted fixed effects method

A further issue with the FE approach relates to the weighting of the unobserved variables. The FE model only accounts for the average impact of the unobserved variables. However, the frequency and the variance of the unobserved variables will differ by route. An alternative estimation strategy would be to apply different weights to different routes to adjust for this.

As far as we are aware, previous studies have not used weighted fixed effects approaches in the airline market context. However, the effects are important – Gibbons *et al.* (2001)[66] find significant changes in the findings of 9 key papers in the American Economic Review if weighted FE is applied to the data used in these papers.

Based on available data, the proposed approach is to use passenger data so as to give a higher weighting to more popular routes in the FE model, and vice versa. Route popularity is considered to be a useful proxy for variation

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66 Gibbons, C., Serrato, J. C., & Urbancic, M. (2011). Broken or Fixed Effects?. Department of Economics, University of California, Berkeley

in unobserved variables as more popular routes would be expected to experience less variation in both fares and capacity following Malév's bankruptcy. Less popular routes might experience more variation as the reactions of Malév competitors would be less predictable – fares may rise by more as there is less competition on the route, or the routes may close down altogether.

The weighting is undertaken by using data on the total number of passengers that travelled along each route during the duration of the panel dataset (January 2003 to December 2013).

A1.3.1.4 The instrumental variables method

Capacity is likely to be a strong driver of average fares, and it would be tempting to simply include an additional capacity variable in the fares model determined in equation 1. However, by doing so, it is likely that endogeneity problems would be created.

Endogeneity is a common issue in any econometric approach. In technical terms endogeneity means that there is correlation between the predictor variables and the error term. In the Malév context endogeneity might occur if capacity on routes adjusts in response to any changes in fares associated with its bankruptcy. This means that the relationship between fares and capacity is 'circular', i.e. capacity influences fares and vice versa. This circularity makes it difficult to split out the factors that might drive fares – so it needs to be corrected for.

There are three likely causes of endogeneity:

- Measurement error;
- Simultaneity, also known as reverse causality; and
- Omitted variables.

These are described as follows:

Measurement error: although there is no specific test or econometric method to deal with measurement error, the problem can be mitigated by carefully choosing the variables used in the econometric model. A thorough preliminary data analysis phase can help uncover any unusual features with the dataset.

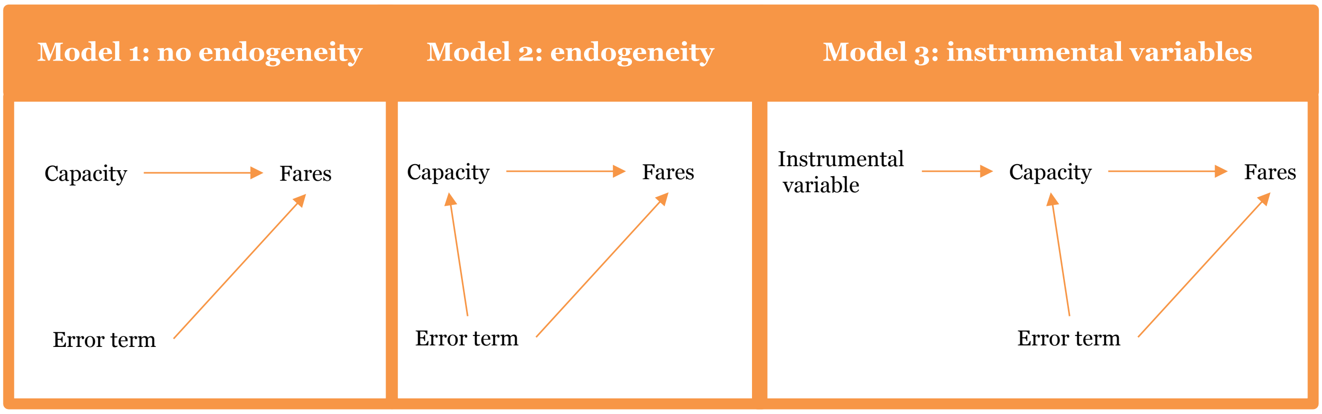
Reverse causality: there is evidence that endogeneity caused by reverse causality is likely to feature in this proposed study (see discussion in Section 1.4). This means that there is a circular relationship embodied in the regression model. In such an event, the regression coefficients are said to be biased and therefore become unreliable.

Omitted variables: a common problem with econometric analysis of air route data sets is that many aspects of airline performance depend on factors that are unobservable to the econometrician. If these factors are correlated with the variables included in the regression then without proper treatment, the regression results become biased. For example, unobserved time variant factors—like variations in airline management quality — are often common across firms in an industry. Failing to control for such factors can cause serious challenges in identifying relationships in the data.

Endogeneity can be treated with what is known technically as instrumental variables (IVs). This is illustrated in a simple process as outlined in Figure 22 below (arrows indicate correlation between variables):

- **Model 1:** capacity is used in the model to help describe fares. In this model the error term and capacity are not correlated so there is no endogeneity. If capacity and the error term are not correlated then the regression is unbiased and no further corrections need to be made.
- **Model 2:** in this model endogeneity is present, leading to the error term and capacity being correlated with each other. This model will estimate biased results.
- **Model 3:** in this model an IV is introduced that is correlated with capacity, but not with the error term. The role of the instrument is to explain fares through capacity, but it must not be correlated with the error term. In practical terms, capacity would be removed from the regression and instead would be replaced by the IV.

Figure 22 – Illustration of the endogeneity issue and instrumental variable treatment



The instrumental variable corrects for the problem of reverse causality described above as it removes the capacity variable that was correlated with the error term. It also accounts for the problem of omitted variable bias. By omitting a key variable, predictor variables such as capacity could become correlated with the error terms – the instruments will remove this correlation. However, this is only a partial step, as described above; existing economic literature is reviewed and used as a guide to structure the regressions used in this analysis. In these circumstances the experience of other researchers is valuable in terms of ensuring consistency with the variables used and removing the problems of omitted variables and measurement error.

A standard approach is to use the lags of the endogenous variable to construct the IV (Wooldridge, 2006)[67], so for the fares model, lagged capacity variables are used as instruments to correct for endogeneity. Similarly, for the capacity model, lagged fares are used as instruments to correct for endogeneity.

A1.3.1.5 The synthetic control method

A key limitation of the FE approach is that the dataset includes only those routes on which Malév used to operate in Hungarian airspace. This can create problems of bias in the regression if the dataset used in this analysis does not represent the complete population of flights into Hungarian airports. This is an issue because this means that the dataset does not capture the drivers of average fares on the Malév routes that, while being unobserved, are accounted for by factors associated with non-Malév routes into airports.

An alternative approach to the FE estimator would be to use an econometric method known as Difference-in-Differences (DiD). This approach has been used previously by Vahter (2009)[68] on an event study about the effects of liberalisation on airline passenger traffic. This approach is designed to measure the difference in average outcomes before and after the collapse of Malév on all air routes in and out of Hungary. The key principle underlying the DiD approach is that it calculates the effect of a 'treatment' on a particular outcome. For the purposes of this study the treatment is Malév's bankruptcy, and the outcome is average air fares.

The DiD approach compares a treatment group (routes into Hungary that Malév operated on) to a control group (non-Malév routes into Hungary) and then tests to see if there are statistically significant differences between these two groups. However, for DiD to be a viable approach, it requires the data relating to the treatment and control group to display comparable properties (e.g. flight frequency, balance of short-haul and long-haul destinations etc.). This is known as the 'parallel trend assumption'. The parallel trend assumption is important as it allows the effects of the bankruptcy to be isolated and not clouded by other outside factors that will influence fares.

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67 Wooldridge, J M. *Introductory Econometrics: A Modern Approach*. Mason, OH: Thomson/South-Western

68 Vahter, P. (2009). The effects of liberalisation on Airline Passenger Traffic: An event study of the enlargement of the EU and the single European aviation market. University of Nottingham working papers.

A detailed examination of the Hungarian routes in the treatment and control groups reveals that the parallel trend assumption does not hold. This is not uncommon in these types of analysis. In such circumstances it is possible to apply a variant of the DiD method known as the 'Synthetic Control Method' (Abadie *et al.*, 2010)[69]. The Synthetic Control Method approach is as the name implies. An artificial or 'synthetic' control group is constructed using particular units of data from routes that Malév's bankruptcy is not expected to have a significant impact on (i.e. routes from outside of Hungary) to best align it to the treatment unit and allow the parallel trend assumption to hold.

Following the notation of Abadie et al. (2010), the following two equations are estimated, where

$$Y_{it}(0) = \lambda_t + \gamma_t Z_i + \delta_t \mu_i + \varepsilon_{it} \qquad \text{(Equation 2.1)}$$

$$Y_{it}(1) = \lambda_t + \tau_{it} + \gamma_t Z_i + \delta_t \mu_i + \varepsilon_{it} \qquad \text{(Equation 2.2)}$$

Where:

- $Y_{it}(l)$ denotes the potential outcome: $Y_{it}(1)$ is the outcome if unit i has been affected by the treatment policy change at time t, $Y_{it}(0)$ if it has not been treated;
- λ_t is an unknown time-specific common factor that is constant across units;
- Z_i a vector of observed explanatory variables that are not affected by the treatment or policy change, with γ_t as a vector of unknown parameters;
- μ_i is a route specific unobservable, with δ_t as a vector of unobserved common factors. In other words, the term $\delta_t \mu_i$ takes some route-specific fixed effects into account.
- τ_{it} denotes the 'treatment effect' on the outcome variable of interest.
- ε_{it} is a transitory shock item with zero mean for all i.

The main objective of the synthetic approach is to estimate the vector τ_it, which denotes the effect of the treatment on the outcome variable of interest. In this case, the treatment is the collapse of Malév, and the synthetic model approach is trying to estimate the effect of the collapse of Malév on aviation fares (i.e. τ_it). In order to do this, a synthetic control group is constructed so that a like-for-like comparison could be made with the treatment unit. In this case, the treatment unit is the 'average' Malév route (i.e. the average of all routes originating from Budapest on which Malév operates on) or a single route originating from Budapest which Malév used to operate on, and the synthetic control group is a synthetic route generated by the model by applying different weights to routes where Malév did not operate on prior to its collapse, so that the final synthetic route closely resembles the average Malév route before the collapse of Malév (i.e. it is the *counterfactual case of what would happen to fares to the average routes originating from Budapest if Malév had not gone bankrupt*).

The rationale for synthetically constructing a control group in such a way is so that the effects of the Malév bankruptcy will not be included in the control group (because it is constructed using only data from routes originating from Budapest where Malév have never operated in), and like-for-like comparisons could be made with the average Malév route (because it was constructed such that the average fare of the synthetic control group aligns with the fare of the average route that Malév operated on prior to its collapse). The difference between the average Malév route and the synthetic control group is then calculated to estimate the size of τ_it, the effect of the Malév bankruptcy on average fares.

Following Abadie et al. (2010), the significance of the estimates of the effect of Malév's bankruptcy on average fares is evaluated by considering 'whether the results could be driven entirely by chance'. Placebo tests are

69 Abadie, A., Diamond, A. and Hainmueller, J. (2009). Synthetic control methods for comparative case studies: estimating the effect of California's tobacco control programme. Journal of the American Statistical Association, Vol. 105, No. 490, Application and Case Studies.

conducted by applying the synthetic control group method to routes to and from airports where Malév's bankruptcy is not expected to have a significant effect on its average fares (i.e. routes that originate from an airport outside of Hungary). If the placebo tests estimate treatment effects of magnitude comparable to the original estimated treatment effect for routes originating from Budapest airport, then the original results would be considered to be inconclusive. On the other hand, if the treatment effect of the Malév bankruptcy on average fares for routes originating from Budapest airport is substantially larger in magnitude than the treatment effects estimated by the placebo tests for routes originating from cities other than Budapest, then it could be interpreted that there is significant evidence that Malév's bankruptcy has a significant impact on average fares.

Furthermore, following Abadie et al (2012)[70], we also assess the significance by the ratio of *root mean square prediction error* (RMSPE) before and after the bankruptcy of Malév. This ratio measures the magnitude of the observed effect after February 2012 relative to the magnitude of random shocks before. If this ratio is close to one, then we could not exclude the probability that the observed effect is due to some random shocks that had been observed before; if this ratio is significantly greater than one, then it is likely that the observed effect could be attributed to the treatment.

Data on all routes originating from four cities in Central and Eastern Europe is collected (Budapest, Prague, Bucharest, and Riga). Prague, Bucharest and Riga are chosen for the placebo tests because of i) data required to run the placebo tests are available for these cities, ii) these cities share similarities with the Budapest aviation market (i.e. they are all cities in the Central and Eastern European region); and iii) it is not expected that these cities will be impacted heavily by the collapse of Malév. As the focus is on the short and medium-haul market, all routes where the distance is greater than 3,500km are excluded. The routes which were not in continuous operation between January 2007 and December 2013 are also removed. After such cleaning, a balanced panel dataset across 84 months for 139 routes is obtained – of which 35 originates from Budapest, 32 originates from Bucharest, 43 from Prague, and 29 from Riga.

In the synthetic control method model, the average fare is regressed against four covariates, which are:

- Seat capacity of chosen route;
- Distance of chosen route;
- Market share of LCCs (in terms of revenue) of chosen route; and
- Total nights spent in hotel or similar accommodation of the destination city.

Further information on the variables is provided in Section 1.4.2 below.

A1.3.2 Capacity model

The central hypothesis behind the capacity model is that Malév's bankruptcy has since led to a reduction in capacity. The core modelling approach is to construct a regression that tests the link between capacity as proxied by average total monthly seats capacity across routes that Malév operated on with a dummy variable that denotes the time periods since Malév's bankruptcy in February 2012. The regression is structured as follows:

$$\log Capacity_{it} = \alpha_i + \sum_t \gamma_t \cdot D_t + \delta_j X_{it} + e_{it}, \qquad \textit{(Equation 3)}$$

Where:

- $Capacity_{it}$ is the average monthly seat capacity of route i at time period t. This is the dependent variable of the model;
- α_i is the constant term;

70 Abadie, Diamond, and Hainmueller (2012), Comparative Politics and the Synthetic Control Method

- D_t is a dummy variable which takes the value zero for the periods where Malév was still operating and one for the periods after Malév's collapse in February 2012. This is the main variable of interest, and the estimated value of the coefficient γ_t provides insights regarding the effects of the Malév collapse on the average fares that consumers have to pay. Note that there is no subscript *i* for this variable. This is because the bankruptcy dummy variable is not route specific, i.e. Malév is bankrupt after February 2012 regardless of the choice of route;
- X_{it} is a matrix of control variables – in this case the average fare is used, the total revenue as a proxy for the route popularity, and a set of seasonal dummies; and
- e_{it} is the model error term.

As with the fares analysis, a similar approach is followed whereby FE, RE, weighted FE and IV models are all implemented.

A1.4 Data description and overview

This section will give a description of the dataset used in the econometric analysis. The data is sourced from the SABRE ADI database.

A1.4.1 Dataset used for fares and capacity models

The initial dataset contain monthly time series data on routes from January 2007 to December 2013 data for 94 destinations served from Budapest, for a total of 188 inbound and outbound routes. After dropping routes where there are gaps with no data during the period January 2007 to December 2013[71], the final panel dataset used for the estimation of the fares and capacity models contain 33 destinations served from Budapest, for a total of 65[72] routes in account for both inbound and outbound journeys. Please note also that the final dataset only contains routes where Malév has operated on[73].

A1.4.1.1 Dataset introduction

Table 9 – List of variables used for fares and capacity econometric analysis

Variable	Description	Units	Source
Number of passengers	Defined as the monthly number of passengers who have booked a ticket on this route. This excludes passenger who were travelling on the route as a leg of a longer journey.	Person	SABRE-ADI
Revenues	Defined as the monthly revenue generated by this route.	USD	SABRE-ADI
Average fare of route	Calculated as revenue divided by number of passengers	USD	PwC generated variable

71 Dropping these routes is necessary for the analysis so the Butterworth filter can only be applied to time series data. A Butterworth filter was applied to the data to deseasonalise the data.

72 The dataset did not contain data for the Budapest to Athens route. Hence the final number of routes is 65, not 66.

73 Ideally, as discussed in Section 1.3.1.5, it would be preferable to adopt a difference-in-difference approach which considers both routes where Malév has operated on and those where Malév did not operate on to estimate the impact of Malév's bankruptcy on average aviation fares in the Hungarian market. However, this method is based on very stringent assumptions. For example, it requires the parallel trend assumption to hold. In this study's context, this means that the set of routes where Malév operated on and where Malév did not operate on have to be identical in every single way prior to the collapse of Malév. As our current dataset does not fulfill these stringent assumptions, the standard FE and FE IV modelling which considers only the routes where Malév operated on have been adopted instead.

Seat capacity	Total number of available seats on a certain route in a certain month	Number	SABRE-ADI
Bankruptcy	It takes the value of one on and after Feb 2012, after Malév demise. Otherwise, it takes the value of zero.	Dummy (0/1)	PwC generated variable
Oil price	Price of Crude Oil, Cushing, OK WTI Spot Price FOB	USD per Barrel	U.S. Energy Information Administration
Bilateral	It takes the value of one when a route ends at a non-EU destination, and there were bilateral agreements between the civil aviation authorities of Hungary and the responsible governments. Otherwise, it takes a value of zero.	Dummy (0/1)	PwC generated variable

Source: PwC analysis

This data have been collected considering only information from passengers flying from origin to destination. Therefore, passengers taking connection flights to other destinations or coming from long-haul non-direct flights are not included in the analysis. The rationale for doing so is because it is not possible to compare direct flight data with non-direct flight data, as no separate fares are paid for the different sections of a non-direct flight.

Destinations have been considered on the basis of cities, rather than airports. This is because low cost carriers (LCCs) are generally not served by the same airports than non-LCCs. As a result, analysing the data at the airport level would have underestimated the true effect as it does not consider all the effect of LCCs on routes serving the same cities.

Table 9 provides a brief description of all the variables that are included in the panel dataset, and where they are sourced from. The variables are collected at the airline level. Airlines included in the dataset includes Malév, flag carriers and other non-LCCs (excluding Malév), and LCCs.

A1.4.1.2 Data description for fare and capacity variables

As the main purpose of this econometric study is to estimate the impact of Malév's bankruptcy on the average aviation fares and capacity in the Hungarian market, exploratory data analysis and descriptive statistics are produced for the average fare and capacity variables in the dataset.

Table 10 below shows the summary statistics for the average fares and capacity before and after the Malév bankruptcy. A comparison between the 12 month mean of the average aviation fare before and after the Malév bankruptcy[74] shows that the average aviation fares in the dataset decreased slightly (around 1.2%) after the Malév bankruptcy. A similar comparison of the 12 month mean of the capacity variable before and after the Malév bankruptcy suggests that capacity has decreased (around 5.2%) after the Malév bankruptcy.

74 A comparison between the 12 month mean before and after the Malév bankruptcy refers to comparing the average of the variable in question during the period February 2011 and January 2012 with the average of the same variable during the period February 2012 and January 2013.

Table 10: Summary statistics of average fares and capacity before and after Malév's bankruptcy

Time period	Variable	No. of observations	Mean		Standard deviation	Min	Max
		Whole sample	*12 months before and after Malév bankruptcy*	*Dec 2012 compared against Dec 2013*	*Whole sample*	*Whole sample*	*Whole sample*
Before Malév bankruptcy	Average fares	3,965	157.60	153.25	41.55	31.98	599.77
	Capacity	3,965	11,410.41	10,705.31	9,167.30	0.00	52,741.64
After Malév bankruptcy	Average fares	1,495	155.71	147.57	39.97	49.38	355.24
	Capacity	1,495	10,818.27	9,690.15	9,420.13	0.00	51,531.00

Source: SABRE ADI, PwC analysis

Table 11 below shows the summary statistics (12 month averages before and after the Malév bankruptcy) for the average fares and capacity for each destination city. The maximum increase seen in fares was 70%, for the Budapest to Stuttgart route, whereas the maximum decrease in fares was -45.8%, for the Budapest to Berlin route. A similar mixed picture could be seen for capacity. The maximum increase in capacity was 129.4%, for the Budapest to Gothenburg route, and the maximum decrease in capacity was -63.1%, for the Budapest to Athens route. It should be noted that the summary statistics shown in Table 11 below are for *non-deseasonalised* fares and capacity data. The % difference observed between the fares and capacity variables before and after the Malév bankruptcy would be more moderate if the same summary statistics are generated for *deseasonalised* variables.

Table 11 – Summary statistics of average fares and capacity before and after Malév's bankruptcy, by destination city

	Fares			Capacity			PAX
	Before Malév bankruptcy (Feb 2011 to Jan 2012)	***After Malév bankruptcy (Feb 2012 to Jan 2013)***	***% difference***	***Before Malév bankruptcy (Feb 2011 to Jan 2012)***	***After Malév bankruptcy (Feb 2012 to Jan 2013)***	***% difference***	***Feb 2011 to Jan 2013***
Amsterdam	136.7	135.9	-0.6%	26030.0	28710.5	10.3%	621,561
Athens	134.6	151.9	12.9%	6368.9	2350.6	-63.1%	41,506
Berlin	174.8	94.7	-45.8%	9735.1	12408.5	27.5%	308,279
Brussels	214.2	152.8	-28.7%	17784.7	25182.1	41.6%	679,479
Bucharest	193.6	142.1	-26.6%	11866.2	5183.0	-56.3%	139,633
Cairo	195.6	208.4	6.6%	1654.3	1631.0	-1.4%	23,535
Copenhagen	143.3	110.7	-22.7%	13765.6	8234.6	-40.2%	281,011
Cypros	175.5	130.1	-25.9%	–	–	–	67,088
Dublin	168.9	169.2	0.2%	8359.1	10272.7	22.9%	292,771
Frankfurt	151.3	174.2	15.1%	26992.8	22406.5	-17.0%	335,080
Geneva	102.7	135.5	31.9%	6066.6	4756.0	-21.6%	179,959

	Fares			Capacity			PAX
	Before Malév bankruptcy (Feb 2011 to Jan 2012)	***After Malév bankruptcy (Feb 2012 to Jan 2013)***	***% difference***	***Before Malév bankruptcy (Feb 2011 to Jan 2012)***	***After Malév bankruptcy (Feb 2012 to Jan 2013)***	***% difference***	***Feb 2011 to Jan 2013***
Gothenburg	153.9	135.3	-12.1%	1935.0	4439.3	129.4%	139,387
Hamburg	150.0	110.6	-26.3%	5516.8	3646.8	-33.9%	114,807
Helsinki	140.4	141.3	0.6%	11041.2	7327.7	-33.6%	209,324
Istanbul	129.4	130.4	0.8%	10199.7	9543.9	-6.4%	194,662
Kiev	153.0	213.2	39.3%	5281.7	3039.5	-42.5%	65,052
London	186.6	170.2	-8.8%	46082.2	50483.1	9.6%	1,511,316
Madrid	168.3	124.6	-26.0%	8428.0	8150.8	-3.3%	269,787
Milan	98.8	123.0	24.5%	13032.3	16206.4	24.4%	454,992
Moscow	221.9	240.3	8.3%	10600.8	7907.2	-25.4%	190,437
Munich	178.9	191.0	6.8%	18796.3	21567.8	14.7%	185,944
Paris	165.1	141.5	-14.3%	27413.8	25147.8	-8.3%	602,726
Prague	199.4	189.4	-5.0%	9519.7	6205.2	-34.8%	131,437
Rome	99.9	98.9	-1.0%	13421.1	15963.8	18.9%	392,184
Stockholm	161.4	127.8	-20.8%	9265.5	3837.3	-58.6%	270,689
Stuttgart	106.2	180.6	70.0%	8034.0	6454.2	-19.7%	230,267
Tel Aviv	222.8	267.7	20.2%	10222.6	4420.5	-56.8%	210,537
Tirgu Mures	72.9	120.8	65.8%	3703.5	2288.8	-38.2%	80,708
Venice	130.8	125.3	-4.2%	1845.0	2282.3	23.7%	63,670
Vienna	167.1	185.4	10.9%	6841.8	7109.3	3.9%	24,537
Warsaw	183.7	170.5	-7.1%	10653.3	11839.3	11.1%	256,143
Zagreb	156.9	134.6	-14.2%	1913.8	3521.7	84.0%	32,689
Zurich	150.6	193.6	28.5%	11651.6	10251.3	-12.0%	193,074
Max			**70.0%**			**129.4%**	
Min			**-45.8%**			**-63.1%**	
Median			**-0.6%**			**-7.3%**	
Weighted Average, by PAX			**-3.3%**			**1.3%**	

Source: SABRE ADI, PwC analysis

Figure 23 – Time series of average fares for all outgoing routes from Budapest in dataset

Source: SABRE ADI, PwC analysis

Figure 24 – Time series of capacity for all outgoing routes from Budapest in dataset

Source: SABRE ADI, PwC analysis

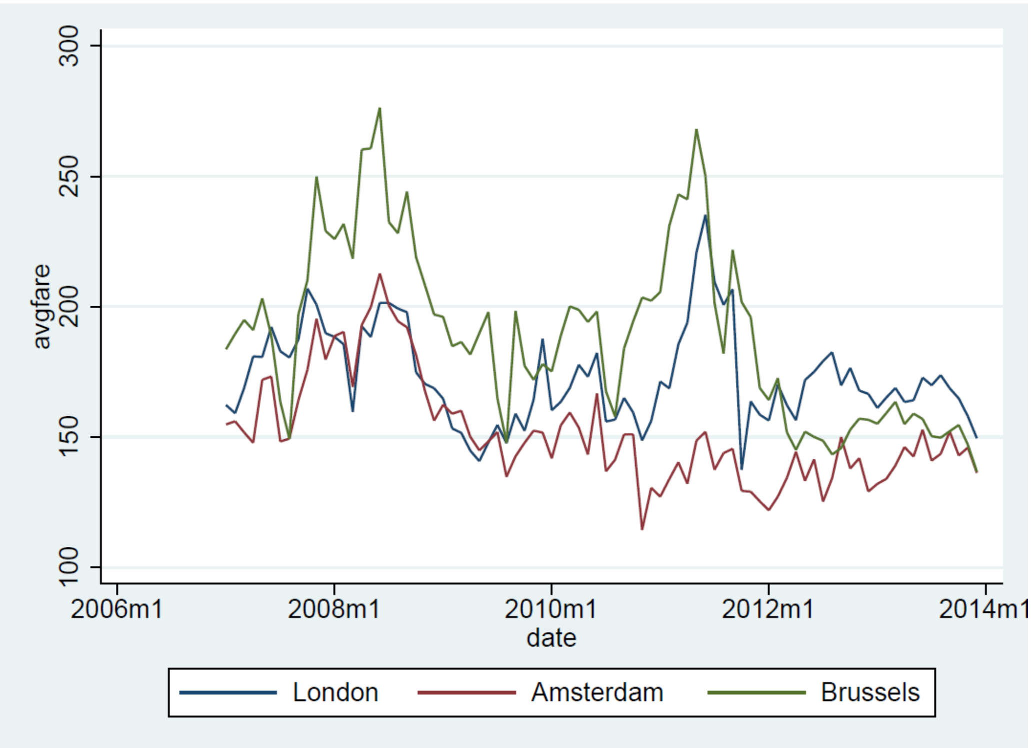
Figure 23 and Figure 24 above show the trends of the deseasonalised average fares and capacity for all outgoing routes from Budapest in the dataset used for this analysis. Upon visual inspection of the time series charts, it is difficult to determine whether there is a definite pattern of whether fares or capacity have decreased or increased after Malév's bankruptcy.

Figure 25 and Figure 26 below shows the time series of deseasonalised fares and capacity respectively for the Budapest to London, Amsterdam and Brussels routes. These three routes were chosen because they were the biggest routes in terms of passenger numbers in our dataset. Visual inspection of Figure 23 provides a bit more colour in interpreting results from Table 11. For example, Table 11 reports that there are relatively large decreases in average aviation fares after the Malév bankruptcy for London and Brussels (-8.8% and -28.7% respectively), whereas for Amsterdam it is a much smaller decrease (-0.6%). This difference is mainly driven by a large spike in aviation fares during the period mid-2010 to 2012. This spike was larger for Brussels and London than Amsterdam, thus pushing up the pre- Malév bankruptcy average aviation fares.

For capacity, it can be seen that there is a slight increase for London and Amsterdam after Malév's bankruptcy. This increase is visually larger for Brussels.

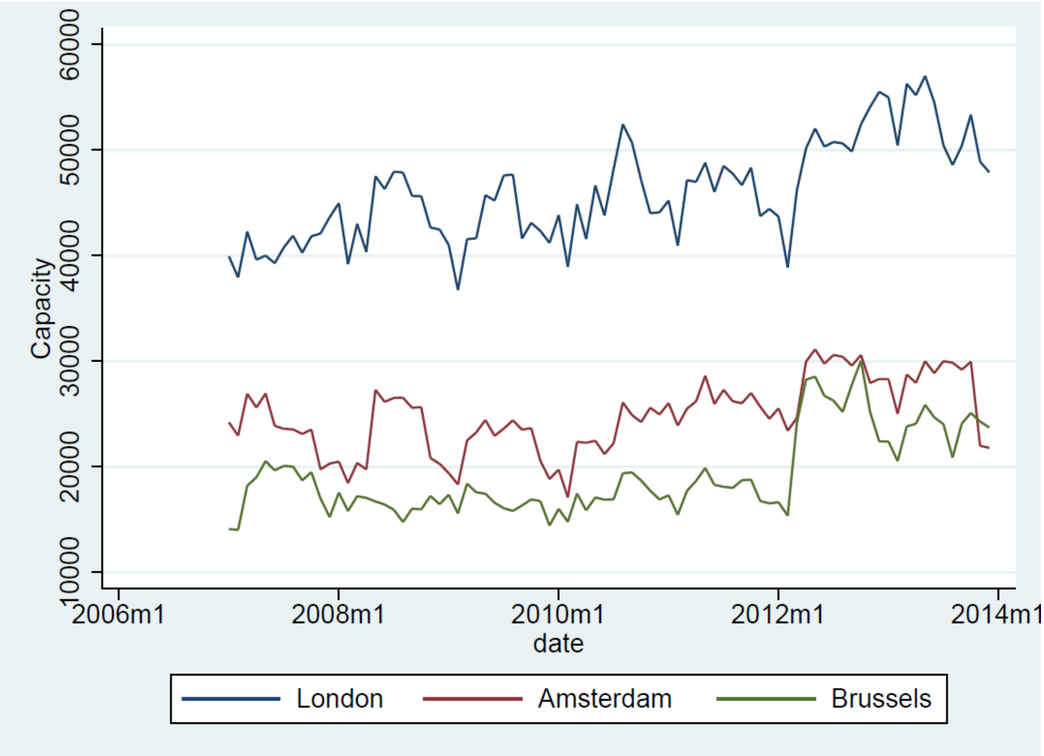
The difference in the % changes in average aviation fares and capacity after Malév's bankruptcy exhibited by different routes highlights that there may be other effects are at play which masks the true impact of Malév's bankruptcy on average fares and capacity. Therefore, regression analysis approach is useful for disentangling these other effects from the main bankruptcy effect which this study is interested in.

Figure 25 – Time series of fares for Budapest to London, Paris and Brussels routes



Source: SABRE ADI, PwC analysis

Figure 26 – Time series of capacity for all Budapest to London, Paris and Brussels



Source: SABRE ADI, PwC analysis

A1.4.1.3 Other data considerations

The following table presents the key summary statistics of the main variables.

Table 12 – Summary statistics for variables used in the capacity model

Variable	No of observations	Mean	Standard deviation	Minimum	Maximum
Number of passengers	5,460	5,309	5,604	13	42,303
Revenues (£)	5,460	847,010	982,554	1,837	7,206,780
Average fare (£)	5,460	157	45	34	628
Overall frequencies per month	5,460	92	62	0	372
Seat capacity	5,460	11,066.72	9,377.4	0	57,015
Distance (km)	5,262	1,043.36	514.27	214.04	2,190.32

Source: PwC analysis

The revenue variable is the most volatile of the variables, as can be seen from the wide minimum and maximum differential – the minimum revenue earned by a route in the data is £1,837, whilst the maximum revenue earned by a route in the data is £7,206,780.

Also, as the dataset contains non-negative minimums, the model will be estimated in its logarithmic form (the criteria of having a non-negative minimum is important because it is computationally impossible to apply a logarithmic transformation to a negative number). Estimating a model in its logarithmic form will allow the estimated model coefficients to be interpreted as elasticities (i.e. a 1% change in the explanatory variable leads to an x% increase or decrease in the dependent variable).

Table 13 – Correlation table

Variable	Seat capacity	Average fare	Revenue	Bankruptcy dummy
Seat Capacity	1.000			
Average Fare	0.155	1.000		
Revenue	0.797	0.287	1.000	
Bankruptcy dummy	-0.001	0.032	0.044	1.000

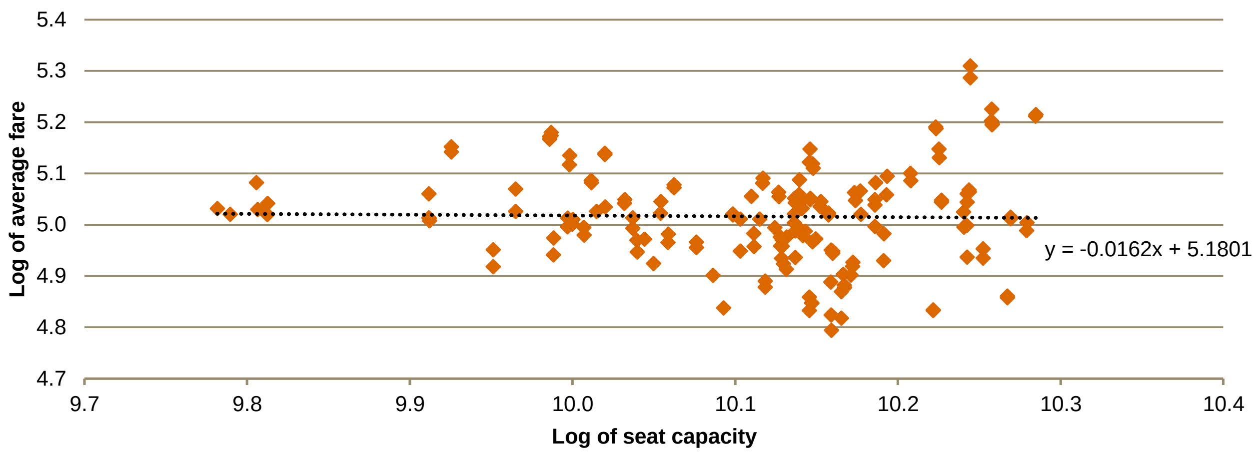
Source: PwC analysis

Table 13 above shows the correlation between the key variables in the dataset. From the relatively low correlation coefficients in the off-diagonal cells of the table, it can be concluded that there is no evidence of multicollinearity[75]. For example, the correlation coefficients of the Bankruptcy dummy with Seat Capacity, Average Fare and Revenue are -0.001, 0.032 and 0.044 respectively. This means that the variables can be used together in the model specification.

Figure 27and Figure 28 are scatter plots between seat capacity and average fares for two popular routes pick at random, Amsterdam and Berlin. A line of best fit and its equation is shown in both scatter plots. Figure 27 suggests that for the Amsterdam route, a 1% increase in seat capacity leads to a 1.6% decrease in average fares, whilst Figure 26 suggests that a 1% increase in seat capacity leads to a 17.2% decrease in average fares. The difference in the relationship between average fare and seat capacity of the route suggests that there route specific effects at play and that these individual route specific effects are important factors to control for when estimating the model.

Therefore, assuming that these effects are fixed over time, using a FE model would help account for any time invariant route specific fixed effects.

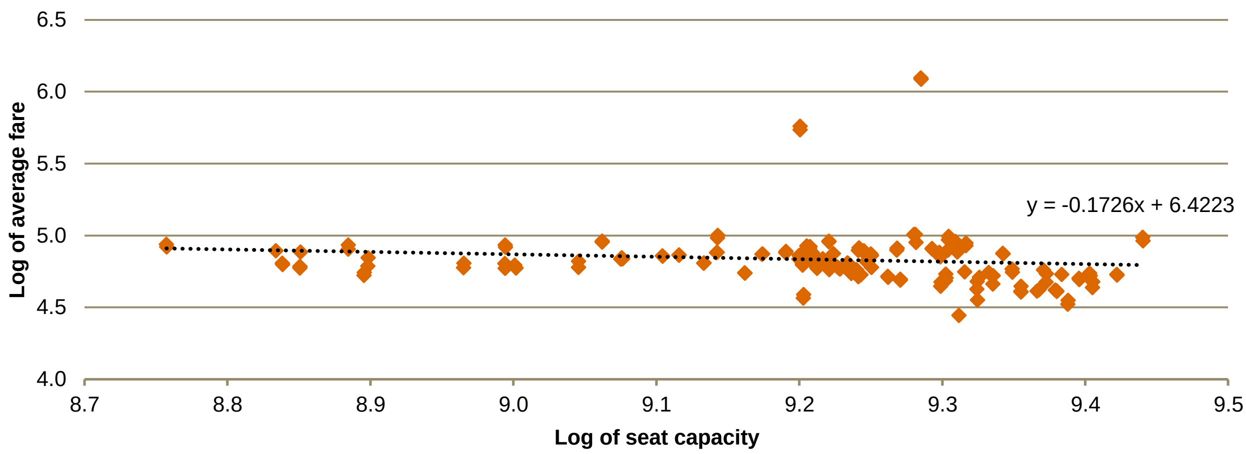
Figure 27 – Scatter plot between log of average fare with log of seat capacity for Budapest – Amsterdam route (both inbound and outbound)



Source: SABRE ADI, PwC analysis

75 A correlation coefficient of one means perfect correlation. For instance, this could be seen in the diagonal cells of Table 5, where the correlation coefficient between the same variables is calculated. A correlation coefficient of zero means no correlation.

Figure 28 – Scatter plot between log of average fare with log of seat capacity for Budapest – Berlin route (both inbound and outbound)

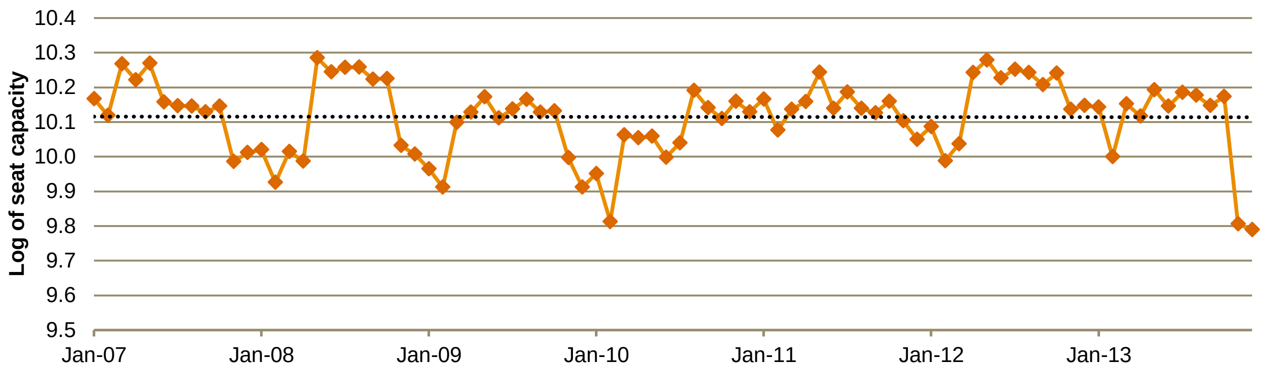


Source: SABRE ADI, PwC analysis

Figure 29 below shows a chart of the log of seat capacity over time. Fitting a line of best fit through shows the seat capacity to be very erratic over time. This can be seen from the fact there are big jumps and spikes in the data over time.

This suggests that a dynamic model (i.e. including the lag of the dependent variable of interest as an explanatory variable) may not be appropriate for the analysis. This is because the erratic nature of the data series makes the predictive/explanatory power of the lag of the dependent variable less powerful.

Figure 29 – Log of seat capacity for Budapest – Amsterdam outbound route, with line of best fit



Source: SABRE ADI, PwC analysis

A1.4.2 Dataset used for the synthetic control method

As mentioned in Section 1.3.1, data on all routes originating from four cities in Central and Eastern Europe is collected (Budapest, Prague, Bucharest, and Riga) for the estimation of the Malév's bankruptcy on average fares using the Synthetic Control Method. These cities were chosen because of i) data required to run the placebo tests are available for these cities, ii) these cities share similarities with the Budapest aviation market (i.e. they are all cities in the Central and Eastern European region); and iii) it is not expected that these cities will be impacted heavily by the collapse of Malév. As the focus is on the short and medium-haul market, all routes where the distance is greater than 3,500km are excluded. The routes which were not in continuous operation between January 2007 and December 2013 are also removed. After such cleaning, a balanced panel dataset across 84 months (January 2007 to December 2013) for 139 routes is obtained – of which 35 originates from Budapest, 32 originates from Bucharest, 43 from Prague, and 29 from Riga.

A qualitative description, and the descriptive statistics of the data used for the Synthetic Control Method could found in Table 14 below.

Table 14: List of variables used for Synthetic Control Method

Variable	Description	Units	Source
Seat capacity	Total number of available seats on a certain route in a certain month	Number	SABRE-ADI
Average distance	Defined as the great circle distance of the route in question. When there is more than one airport at either destination, a weighted average of routes is used.	km	SABRE-ADI/PwC generated
Market share of Low Cost Carriers (LCCs)	This is the market share of Low Cost Carriers (LCCs) for the route in question. Computed by PwC analysis using data from the Sabre ADI database. This is calculated by taking the ratio between the revenue earned by LCCs and the total revenue earned by all airlines for a route in question.	%	SABRE-ADI/PwC generated
Total nights spent in hotel or similar accommodation	This is the monthly total number of nights spent in a hotel, or similar accommodation at the destination city. This is used as a proxy for the demand for flights for a destination city.	Number	Eurostat

A table of descriptive statistics of the data used for the Synthetic Control Method could be found in Table 31 in Appendix B.

A1.5 Model results: fares analysis

In this section the impact of Malév's bankruptcy on average aviation fares in the Hungarian market is considered. Results from the OLS, FE, weighted FE, IV FE and SCM models are presented and their usefulness and key findings are discussed in turn.

A1.5.1 Panel fixed effects regression models

Table 15 below reports the estimation results for five models. Models 1 is a simple panel fixed effects univariate regression model that regresses the log of average fare of the route in question against the 'Bankruptcy dummy', a variable which aims to capture the impact of Malév's bankruptcy on average aviation fares in the Hungarian market[76].

76 A fixed effects model was chosen over a random effects model after a Sargan-Hansen test was performed. The null hypothesis of the Sargan-Hansen test is "that 'the estimators of the RE model are both consistent and efficient' (i.e. the RE model is preferred over the FE model). The p-value for the Sargan-Hansen test is 0.0319, meaning that the null hypothesis can be rejected at the 5% significance level, i.e. the FE model is preferred.

Table 15 – OLS and panel regression models

Dependent variable	Log of average fare of route				
	Model 1	Model 2	Model 3	Model 4	Model 5
	Panel fixed effects model with bankruptcy dummy	**Panel fixed effects model with bankruptcy dummy and seasonal dummies**	**Panel fixed effects model with bankruptcy dummy, seasonal dummies and oil prices**	**Weighted panel fixed effects model with bankruptcy dummy, seasonal dummies and oil prices**	**Weighted panel fixed effects model with bankruptcy dummy, seasonal dummies and oil prices, excluding routes where there are no bilateral trade agreements between Budapest and the destination city**
Bankruptcy dummy	-0.019	-0.021	-0.057	-0.093	-0.107
	(0.007)***	(0.026)	(0.027)**	(0.026)***	(0.028)***
Q2 seasonal dummy		0.068	0.052	0.052	0.054
		(0.008)***	(0.009)***	(0.007)***	(0.007)***
Q3 seasonal dummy		0.041	0.020	0.019	0.016
		(0.009)***	(0.010)**	(0.010)*	(0.011)
Q4 seasonal dummy		0.015	0.005	-0.001	-0.000
		(0.006)**	(0.006)	(0.006)	(0.006)
Oil price			0.193	0.181	0.182
			(0.021)***	(0.016)***	(0.018)***
Constant term	5.023	4.992	4.161	4.254	4.232
	(0.003)***	(0.009)***	(0.087)***	(0.067)***	(0.073)***
'Within route' R^2	0.00	0.02	0.06	0.08	0.09
Number of observations	5,460	5,460	5,460	5,460	4,620

*Key to table: * p<0.1; ** p<0.05; *** p<0.01*

Source: PwC analysis

The coefficient of the Bankruptcy dummy in the FE model is -0.019, which is interpreted as 'Malév's bankruptcy has decreased the average fares of routes by 1.9%'. This coefficient is significant at the 1% level.

Model 2 builds upon Model 1 by adding in seasonal dummies. The coefficient on the Bankruptcy dummy is -0.021, which is interpreted as 'Malév's bankruptcy has decreased the average fares of routes by 2.1%'. The Bankruptcy dummy variable in Model 2 is not statistically significant at the 10% level.

Model 3 builds on Model 2, by including the oil price as an explanatory variable in the model specification. The coefficient on the bankruptcy dummy is now -0.057, which is interpreted as 'Malév's bankruptcy has decreased the average fares of routes by 5.7%'. The bankruptcy coefficient is statistically significant at the 5% significance level. The coefficient on the oil price variable is 0.19, which is interpreted as a 1% increase in oil price increases the average aviation fares by 0.19%. The sign and magnitude of this result is reasonable, and it is statistically significant at the 1% significance level.

Model 4 takes the same model specification 3, but modifies the core FE approach by weighting each observation to account for differences in route population. As described in Section 1.3.1.3, the weights used are each route's respective passenger numbers. In this model specification, the coefficient on the bankruptcy dummy is -0.093, and is statistically significant at the 1% level. The coefficient on the oil price variable is 0.18, and is statistically significant at the 1% level. Model 4 is the preferred model specification out of the five models presented in Table 15above.

Model 5 is similar to Model 4, but incorporates the following modifications to the model specification: Model 5 drops routes where there are bilateral agreements between Budapest and the destination city (i.e. routes where the Bilateral dummy variable is equal to 1) from its dataset. The coefficient on the bankruptcy variable is -0.036 and is statistically significant at the 1% level. The oil price variable is once again positive (coefficient is 0.23), and statistically significant at the 1% level.

Although capacity is an important factor to consider, this was not included in the models presented in this section due to the endogeneity problems described in Section 1.3.1.4. As described in Section 1.3.1.4 endogeneity problems can be controlled for through the use of IV's. This is discussed in the next sub-section.

A1.5.2 The IV approach

It is important to control for any changes in capacity that may have been caused by Malév's bankruptcy when considering its impact on average aviation fares. However, as discussed in Section 1.3.1.4, the inclusion of capacity in a standard panel fixed effects model will introduce the econometric problem of endogeneity, which leads to biased results. To account for this, a fixed effects instrumental variable (FE IV) model was used. Table 16 below report the estimation results of the FE IV models.

Models 1 and 2 in Table 16 use various lags of capacity to instrument for current capacity[77]. Model 1 uses the 2nd and 12th lags of capacity to instrument for current capacity; Model 2 uses the 6th and 12th lags of capacity to instrument for current capacity.

To evaluate the robustness of the FE IV model using the lags of capacity as an instrument for current capacity, three specification tests were conducted. They test for the validity and relevance of the choice of instrumental variables. In the field of statistical analysis, a good instrumental variable needs to be both valid and relevant. Validity refers to whether the instrumental variables are uncorrelated with the error term of the main fixed effects model. Relevance refers to whether the instrumental variables are correlated with the endogenous variable that you want to instrument for:

- **Hansen J test:** This tests for the validity of the choice of instrumental variables. The null hypothesis is that *'the variables chosen are valid instruments of the endogenous variable'*. The p-value of this for both Models 1 and 2 are above 0.05, which means that the null hypothesis cannot be rejected at the 5% significance level, i.e. the choice of instruments is valid.
- **Kleibergen-Paap test:** This tests whether the chosen instrumental variables are relevant or not. The null hypothesis is that *'the variables chosen are not relevant instruments of the endogenous variable'*. The p-value of the test for both Models 1 and 2 are 0.000, which means that the null hypothesis can be rejected at the 1% significance level, i.e. the choice of instruments is relevant.
- **Cragg-Donald Wald F test:** This tests whether the chosen instrumental variables are weakly identified or not (i.e. whether these are poorly correlated with the endogenous variable). The null hypothesis is that *'the instrumental variables chosen are weakly identified'*. The Wald F statistic for Models 1 and 2 are 2319.7

77 Wooldridge (2008) argues that if a given explanatory variable x is found to be endogenous, then its own lagged values might be used as instruments as they are likely to be correlated with x, the endogenous variable, and unlike x, they will not be correlated with the current period error term, since they were generated at an earlier point in time. A very important caveat here relates to autocorrelated errors. Where the errors are correlated, then the presumed exogeneity or validity of the instruments will be in doubt. As Wooldridge (2008) points out, tests for autocorrelated errors should be conducted and in the presence of autocorrelation, more distant lags might be used to mitigate this concern.

and 499.0 respectively, which means that the null hypothesis can be rejected at the 10% significance level[78] i.e. the choice of instruments are not poorly correlated with the endogenous variable.

The coefficients on the bankruptcy dummies in Models 1 and 2 are -0.080 and -0.086 respectively, and both are statistically significant at the 1% level. These suggest that according to Model 1 (Model 2), Malév's bankruptcy has led to a 8.0% (8.6%) decrease in average aviation fares. The coefficients on the oil price variable are 0.186 and 0.189 for Models 1 and 2 respectively. These suggest that according to Model 1 (Model 2), a 1% increase in oil price leads to a 0.186% (0.189%) increase in average aviation fares. It is also noted that these results are similar to the estimated coefficients on the bankruptcy dummy and the oil price variable in Model 4 in Table 15 above.

Table 16 – Weighted fixed effects instrumental variable model, using lags as instruments

Dependent variable	**Log of average fare of route**			
	Model 1	**Model 2**	**Model 3**	**Model 4**
	FE IV model using 2nd and 12th lags of seat capacity as IV	**FE IV model using 6th and 12th lags of seat capacity as IV**	**FE IV model using unemployment and production as IV**	**FE IV model using 2nd and 12th lags of seat capacity, unemployment and production as IV**
Log of monthly seat capacity of route	-0.094	-0.186	0.238	-0.042
	(0.016)***	(0.028)***	(0.111)**	(0.017)**
Bankruptcy dummy	-0.080	-0.086	-0.106	-0.102
	(0.007)***	(0.007)***	(0.009)***	(0.008)***
Q2 seasonal dummy	0.069	0.082	0.020	0.059
	(0.010)***	(0.010)***	(0.018)	(0.011)***
Q3 seasonal dummy	0.040	0.054	-0.012	0.035
	(0.010)***	(0.010)***	(0.019)	(0.011)***
Q4 seasonal dummy	-0.010	-0.004	-0.017	-0.015
	(0.010)	(0.010)	(0.013)	(0.011)
Oil Price	0.186	0.189	0.164	0.170
	(0.014)***	(0.014)***	(0.016)***	(0.016)***
R^2	0.09	0.07	-0.00	0.10
N	4,489	4,489	3,754	3,205
Under-identification test (Kleibergen-Paap test)	0.0000	0.0000	0.0521	0.0000

78 Here, instead of the p-value, the test statistic of this test is considered instead – if this is above the 'Stock-Yogo' critical value, then the conclusion is that the instruments are not weak. The Stock-Yogo critical value is 19.93 at the 10% significance level. Since the test statistic is greater than the critical value, the test results suggest that the model does not have a weak identification problem. Stata only reports critical values up to the 10% significance level for the Cragg-Donald Wald F test.

Dependent variable	Log of average fare of route			
	Model 1	Model 2	Model 3	Model 4
	FE IV model using 2nd and 12th lags of seat capacity as IV	FE IV model using 6th and 12th lags of seat capacity as IV	FE IV model using unemployment and production as IV	FE IV model using 2nd and 12th lags of seat capacity, unemployment and production as IV
Weak identification test (Cragg-Donald Wald F statistic)[79]	2319.737 (19.93)	499.003 (19.93)	42.007 (19.93)	1012.115 (24.58)
Instrument validity test (Hansen J statistic)	0.3135	0.0699	0.0088	0.0000

*Key to table: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. The p-values of the Hansen J and Kleibergen-Paap tests are presented. The Cragg-Donald Wald F statistics are reported.*

Source: PwC analysis

However, it should be noted that although the use of lags of the problem variable as an instrument has precedent in academic literature, it is not perfect, and one of the key criticisms is that the estimation results are sensitive to the lags that are selected as instruments.

In light of this, an alternative approach where macroeconomic variables are used as instruments for the current capacity was attempted. Three macroeconomic variables, namely monthly unemployment rate and monthly production in industry of the destination cities were used as instruments for the current capacity. More details of the macroeconomic variables are documented in Table 17 below.

Table 17 – Macroeconomic variables used as instrumental variables

Variable	**Data availability**	**Source**
Monthly unemployment rate	Austria, Belgium, Cyprus, Czech Republic, Denmark, Egypt, France, Germany, Greece, Ireland, Israel, Italy, Netherlands, Romania, Russia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom	Thomson Reuters Datastream
Monthly production in industry	Austria, Belgium, Cyprus, Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Romania, Spain, Sweden, Turkey, United Kingdom	Eurostat

Models 3 and 4 in Table 16 above shows the FE IV models where the macroeconomic variables were used as candidate instruments. Model 3 uses the destination country's unemployment rate and industrial production as instruments for capacity; and Model 4 uses the 2nd and 12th lag of capacity, unemployment rate & industrial production as instruments.

As discussed earlier in this section, a good instrument needs to be both valid and relevant. In order to assess this, the Kleibergen-Paap test, Cragg-Donald Wald F test and the Hansen J test were one again conducted.

79 The value within the brackets indicate the 10% critical value of the Stock-Yogo weak ID test.

Model 3 fails to pass the Kleibergen-Paap test (it has a p-value greater than 0.05), and Model 4 fails to pass the Hansen J test (the p-value is lower than 0.05, meaning that the null hypothesis instrument validity is rejected).

A1.5.3 The synthetic control method

So far in this report, the modelling results for the FE, weighted FE and IV FE approach have been presented. However, as described in Section 1.3.1.5, a key limitation of the FE approach is that the dataset includes only those routes on which Malév used to operate in Hungarian airspace. To account for both types of routes, the Synthetic Control Method described in Section 1.3.1.5 is used, and the results of this method are presented below.

It is worth spending time to define the naming conventions that will be used in the discussion of the results. When this report refers to the 'Budapest' route, it is referring to the 'average' route that originates in Budapest. Similar interpretations could be used when this report makes mentions of the 'Prague', 'Bucharest' and 'Riga' routes.

Table 18 below displays the weights of the routes used to construct the synthetic Budapest route (i.e. a synthetically constructed route that mimics the actual Budapest route). The reported weights indicate that trend of the fare for the Budapest route before Malév's collapse is best mimicked by a combination of 49 routes, with all other routes assigned zero weights[80].

Table 18 – Route weights used to construct the 'synthetic' Budapest

Route	Weight	Route	Weight
Bucharest – Rome	27.0%	Riga – Bergen	0.6%
Prague – Manchester	14.4%	Riga – Berlin	0.6%
Prague – Duesseldorf	5.5%	Riga – Duesseldorf	0.6%
Bucharest – Duesseldorf	4.8%	Riga – Hamburg	0.6%
Prague – Barcelona	3.1%	Riga – Kiev	0.6%
Bucharest – Milan	2.7%	Riga – Minsk	0.6%
Prague – Oslo	2.5%	Riga – Oslo	0.6%
Bucharest – Barcelona	2.4%	Riga – Tbilisi	0.6%
Prague – Rome	2.4%	Riga – Amsterdam	0.5%
Prague – Milan	2.3%	Riga – Barcelona	0.5%
Bucharest – Madrid	2.2%	Riga – Brussels	0.5%
Prague – Copenhagen	2.1%	Riga – Copenhagen	0.5%
Bucharest – Larnaca	2.0%	Riga – Dublin	0.5%
Prague – Zurich	1.8%	Riga – Frankfurt	0.5%
Bucharest – Brussels	1.4%	Riga – Istanbul	0.5%
Bucharest – London	1.4%	Riga – London	0.5%

80 The available routes that can be used to construct the synthetic Budapest route is described in Section 1.4.2.

Route	Weight	Route	Weight
Prague – Cologne-Bonn	1.4%	Riga – Milan	0.5%
Prague – London	1.4%	Riga – Moscow	0.5%
Prague – Bristol	1.3%	Riga – Munich	0.5%
Prague – Leeds/Bradford	1.3%	Riga – Paris	0.5%
Riga – Helsinki	0.7%	Riga – Stockholm	0.5%
Riga – Kaliningrad	0.7%	Riga – Vienna	0.5%
Riga – Tallinn	0.7%	Riga – Zurich	0.5%
Riga – Vilnius	0.7%	Riga – Tashkent	0.4%
Riga – Warsaw	0.7%		

Note: All other routes have zero weight.

Source: PwC analysis

Table 19 below shows the averages of various variables of the actual Budapest route and the synthetic Budapest route prior to Malév's bankruptcy in February 2012. Although it can be seen from Table 20 below that the averages of the key characteristics of the synthetic Budapest route align closely with the averages of the actual Budapest route, there is some evidence of poor matching between the synthetic control group and treated unit. This will be further discussed below.

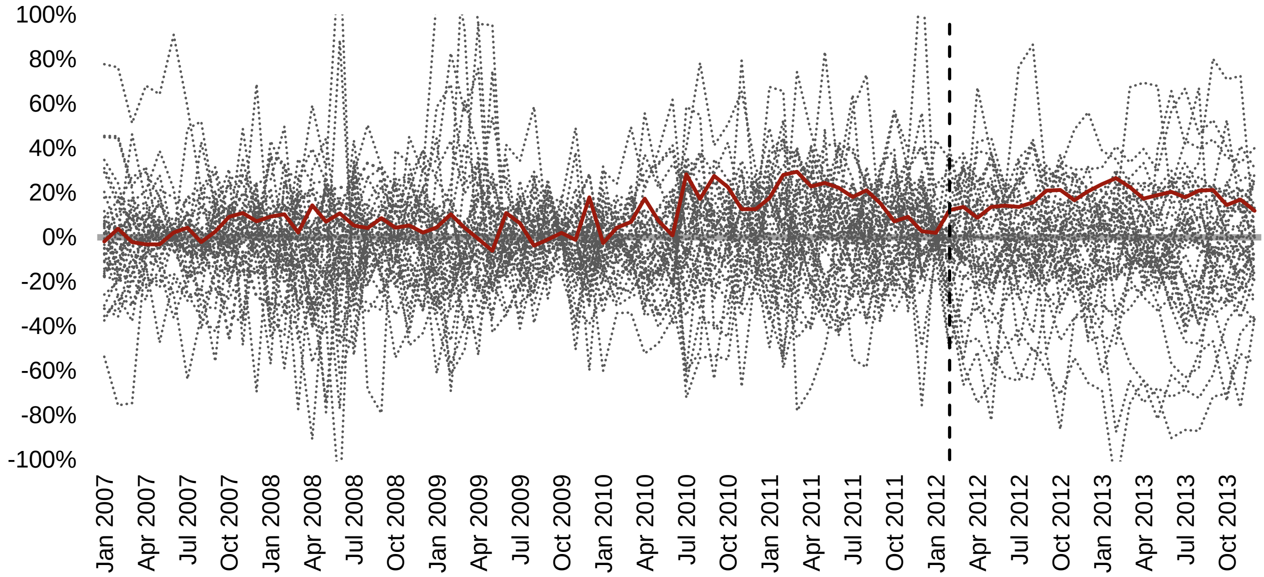
Table 19 – Variable averages before Malév bankruptcy

Variable	Actual Budapest route (Variable averages prior to Malév bankruptcy)	Synthetic Budapest route (Variable averages prior to Malév bankruptcy)
Logarithm of average fares	4.88	4.80
Logarithm of distance	6.99	6.96
Logarithm of total nights spent in hotels	13.30	13.26
Logarithm of average fares in June 2007	4.94	4.92
Logarithm of average fares in July 2009	4.82	4.80
Logarithm of average fares in January 2012	4.72	4.70

Source: PwC analysis

The effect of Malév's bankruptcy is estimated by the difference between fare of the actual Budapest route and the predicted fare of the synthetic Budapest route, as shown in the red line in Figure 30. Between April 2010 and December 2011, the average fare on the Budapest route had significantly diverged from its synthetic counterpart. Immediately after Malév's demise, the gap starts to diverge from zero noticeably again. This suggests that the failure of Malév has a one-off effect on the average fare for flights originating from Budapest. The results suggest that, on average, Malév's bankruptcy may have increased average fares by between 10% and 20%.

Figure 30 – Placebo test comparing Budapest treatment effect with other individual synthetic control routes



Source: PwC analysis

But is this result significant? Following Abadie *et al.* (2010)[81] , the significance of the estimates of the impact of Malév's bankruptcy on fares are evaluated by considering 'whether the results obtained could be driven entirely by chance'. Placebo tests are run by re-conducting the synthetic control group method for routes where Malév's bankruptcy is not expected to have a significant effect on its average fares (i.e. in the case of this analysis, these are routes that originate from an airport other than Budapest), and see whether the treatment effect (i.e. the impact of Malév's bankruptcy on fares) could be observed or not.

In order to assess the validity of the result, placebo tests are conducted using individual routes[82] from Bucharest, Prague, and Riga as comparators, as these are the most comparable routes to those originating from Budapest which are also unlikely to be directly affected by Malév's bankruptcy. If it is found that the gaps between the actual and the synthetic control routes from the placebo tests are comparable in magnitude to the gap between the actual and synthetic Budapest route, then the results of the Synthetic Control Method are considered to be inconclusive. On the other hand, if it can be shown the gap between the actual and synthetic Budapest route is larger than the gaps between the actual and synthetic control routes, then this can be interpreted as evidence that the impact of Malév's bankruptcy on fares is significant.

The results of the placebo tests are presented in Figure 30. The solid red line denotes the % difference between the fares of the actual and synthetic Budapest route. The grey lines denote the % difference between the fares for each individual route between the actual and synthetic cases respectively. Figure 30 is not conclusive about whether this effect is significant or due to other random shocks, as the increase in the % difference between the fares of the actual and synthetic Budapest route (i.e. the red line) does not seem out of line with the % difference exhibited by other routes, which should not be affected by Malév's bankruptcy (i.e. the grey lines).

81 Abadie, A., Diamond, A. and Hainmueller, J. (2009). Synthetic control methods for comparative case studies: estimating the effect of California's tobacco control programme. Journal of the American Statistical Association, Vol. 105, No. 490, Application and Case Studies.

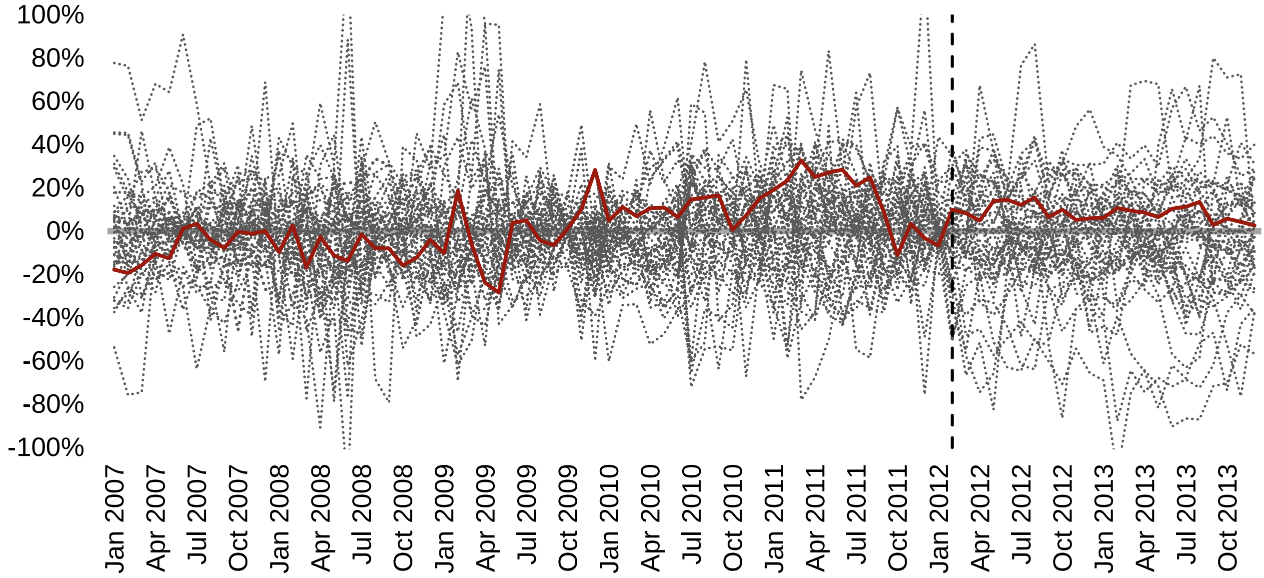
82 However, it should be noted that individual routes are expected to demonstrate higher variability than the weighted averages. Hence a placebo test based on individual routes would have a higher noise than the Budapest treatment effect, rendering its Type II error to be high and hence relatively inefficient.

Furthermore, the fare for the Budapest route has also been above its synthetic counterpart by the similar magnitude between April 2010 and December 2011, which could only be explained by factors other than the Malév bankruptcy. It is probable that such other factors or random shocks could have also caused the uptick after the bankruptcy as well, and hence the evidence is inconclusive about whether the effect is due to Malév's bankruptcy.

In order to understand the drivers behind the average Budapest route's behaviour, we have also conducted SCM analysis on individual routes originating from Budapest. In Figure 30 and Figure 31 below, we present the results for the Budapest-London and Budapest-Warsaw route. In each figure, the solid coloured line represents the gap between the analysed route and its synthetic counterpart, while the grey lines are placebo tests based on individual lines.

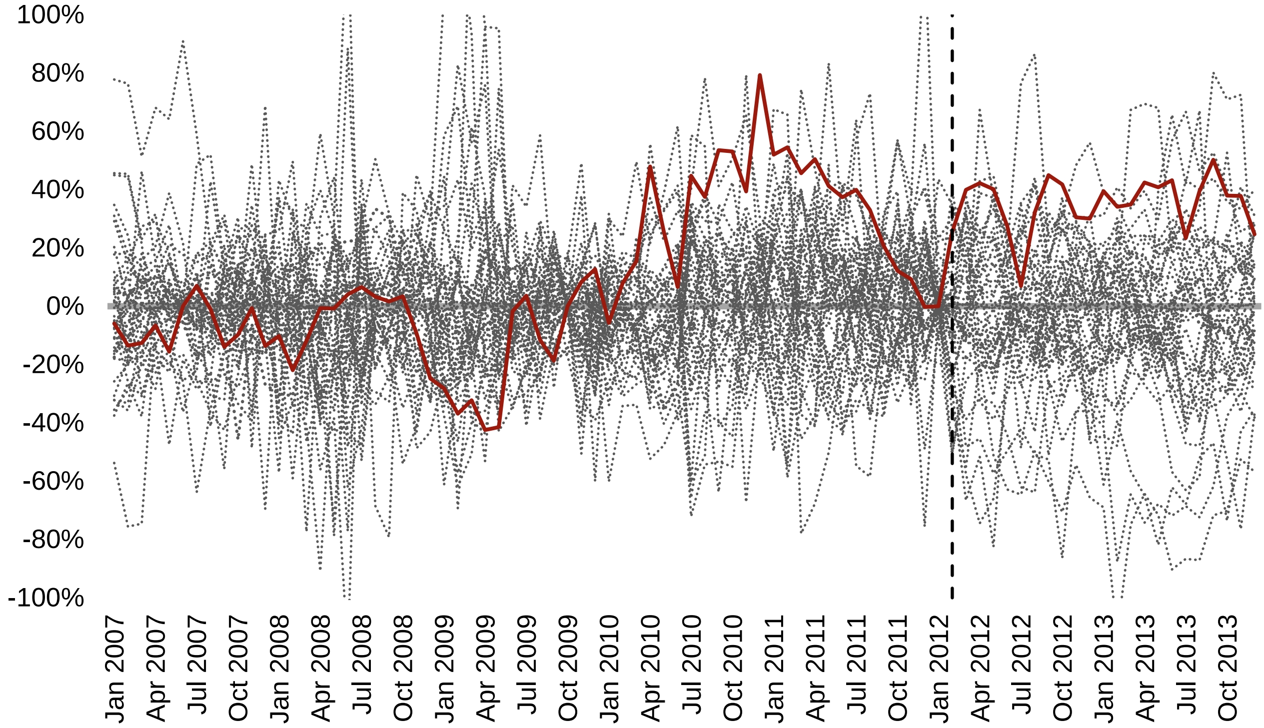
Figure 31 and Figure 32 is similar to Figure 30, except that it shows the comparison between treatment effects for specific components of the average Budapest route (i.e. Budapest to London and Budapest to Warsaw respectively) with the other individual synthetic control routes. As shown in Figure 31 and Figure 32, components of the average Budapest route (i.e. the red lines in Figure 31 and Figure 32) are very different from each other. Furthermore, individual routes are more affected by random shocks and idiosyncratic factors than the weighted average (i.e. the red line in Figure 30). However, in general, the results from the analyses of individual routes point to a similar conclusion as Figure 30 – that is, while the estimations show an uptick of various degrees after the Malév bankruptcy, it is not significantly larger than variations from the synthetic counterpart due to other factors and/or random shocks before the Malév bankruptcy. Therefore, the evidence is inconclusive with respect to the impact of the collapse of Malév.

Figure 31 – Placebo test comparing the effect on the Budapest-London route with other individual synthetic control routes



Source: PwC analysis

Figure 32 – Placebo test comparing the effect on the Budapest-Warsaw route with other individual synthetic control routes



Source: PwC analysis

To quantify the significance of the effect of the Malév bankruptcy, the ratio between the *root mean square prediction error* (RMSPE) after the bankruptcy and the RMSPE before is considered, which represents the magnitude of the observed effect after February 2012 relative to the magnitude of random shocks before. In other words, the inverse of the ratio represents the upper bound to the probability if a route were to be picked randomly from the sample, the chances of obtaining a ratio as RMSPE ratio equally high. As Table 20 below shows, the evidence from the SCM analyses had been inconclusive.

Table 20 – Root Mean Square Prediction Error

	Weighted average of all Budapest routes	Budapest – London	Budapest – Warsaw	Budapest – Brussels
RMSPE before	0.1254	0.1425	0.2782	0.1902
RMSPE after	0.1810	0.0938	0.3641	0.1464
After/before	1.4433	0.6580	1.3091	0.7695
Maximum p-value	**0.6900**	**1.0000**	**0.7600**	**1.0000**

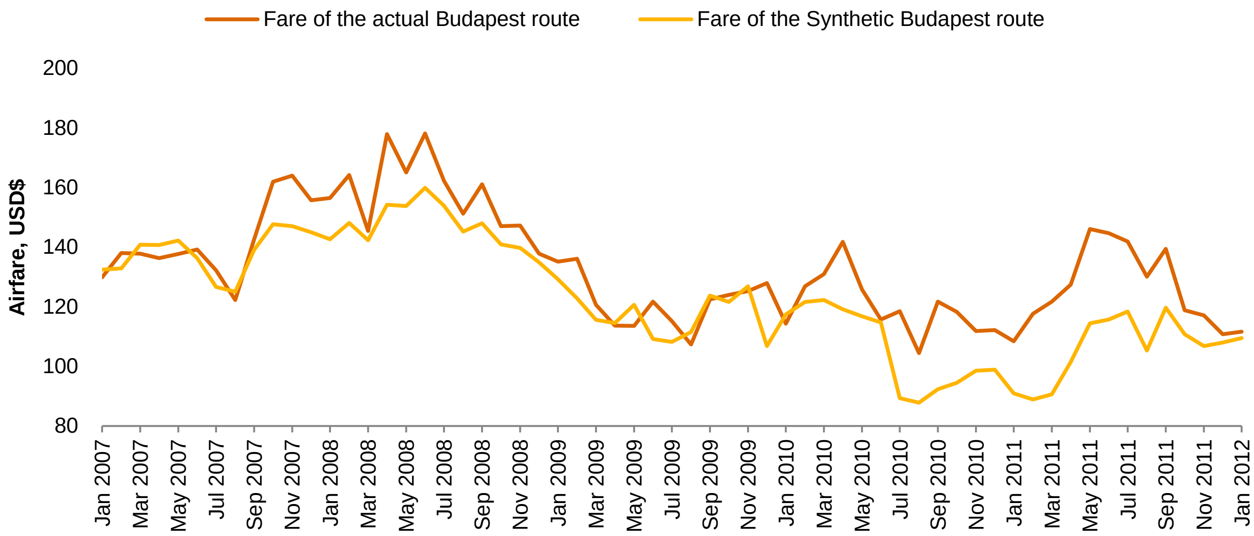
Source: PwC analysis

Whilst the Synthetic Control Group method is useful for synthesising an appropriate counterfactual route for comparison, the following limitations of this study are noted.

Firstly, all comparator routes originate from one of the following three cities: Bucharest, Prague or Riga, and hence it is expected any idiosyncratic shocks that affected any one of them after Malév's bankruptcy would have a significant impact on the synthetic composite's predictions (i.e. due to the fact that only three cities are used in the construction of the synthetic control group, a shock to any of these cities would impact the path of the synthetic control group more than if more cities were used to construct the synthetic control group). This in turn would affect the estimated treatment effect, evaluated as the gap between actual treated observations and predicted values based on the synthetic control.

Secondly, with only two explanatory variables, the fit between the actual fares and their synthetic counterpart is not ideal. In other words, there is a considerable amount of noise that remains in the difference between the actual and synthetic fares. As Figure 33 below illustrates, the synthetic control group clearly fails to mimic the behaviour of the treated unit over the pre-treatment period. Consequently, the effect of Malév's bankruptcy on average fares may be difficult to isolate from the 'noise'.

Figure 33 – Comparison of the airfare between the actual Budapest route with the synthetic Budapest route prior to Malév's bankruptcy



Source: PwC analysis

Due to reasons set out above, the results from the Synthetic Control Groups study were not conclusive.

A1.6 Model results: capacity analysis

This section discusses the impact of Malév's bankruptcy on airline route capacity. Similar to the fares model reported earlier, a number of econometric models are estimated. First, in Table 21 below, the results of six econometric models based on panel FE weighted or weighted are presented. Each of the six models uses the monthly total number of seats available on flights to and from Budapest as the dependent variable. The route specific predictor variables are; the average fare, the Malév bankruptcy dummy, world oil prices, and a set of seasonal dummies to control for seasonality effects.

The rationale for choosing FE models instead of RE is based on preliminary statistical tests such as the Hausman and Sargan-Hansen both of which find the FE to be the preferred model. To recap, the null hypothesis of the Hausman test is that *"the estimators of the RE model are both consistent and efficient"* (i.e. the RE model is preferred over the FE model). The p-value of the Hausman test is zero, which means that the null hypothesis can be rejected at the 1% significance level, i.e. the FE model is preferred.

Table 21 – Econometric models based on weighted and un-weighted Panel FE models

Dependent variable	**Log of average capacity of route**				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
	Panel fixed effects model with bankruptcy dummy	Panel fixed effects model with bankruptcy dummy and seasonal dummies	Fixed effects model with bankruptcy dummy and seasonal dummies	Weighted fixed effects model with bankruptcy dummy and seasonal dummies	Weighted fixed effects model with bankruptcy dummy, seasonal dummies and oil price (bilateral==0)
Bankruptcy dummy	-0.122	-0.128	-0.132	-0.055	-0.041
	(0.052)**	(0.052)**	(0.053)**	(0.045)	(0.047)
Q2 seasonal dummy		0.152	0.150	0.137	0.136
		(0.018)***	(0.017)***	(0.016)***	(0.017)***
Q3 seasonal dummy		0.161	0.158	0.143	0.139
		(0.021)***	(0.020)***	(0.018)***	(0.018)***
Q4 seasonal dummy		0.063	0.062	0.065	0.059
		(0.011)***	(0.011)***	(0.007)***	(0.007)***
Oil Price			0.021	0.028	0.016
			(0.028)	(0.023)	(0.025)
Constant term	9.092	9.000	8.909	9.406	9.521
	(0.014)***	(0.019)***	(0.127)***	(0.104)***	(0.113)***
'Within route' R^2	0.03	0.08	0.08	0.07	0.07
Number of observations	5,262	5,262	5,262	5,262	4,422

*Key to table: * p<0.1; ** p<0.05; *** p<0.01*

Source: PwC analysis

The above models suggest that the effect of the bankruptcy dummy is either not statistically different from zero (see Models 4 and 5) or between -0.122 to -0.132 per cent (see Models 1 to 3). The coefficients in Models 1 to 3 are only significant at the 5% level. Interestingly, the coefficients on the bankruptcy dummy stay largely similar across the various model specifications.

However, the above models are likely to suffer from omitted variable bias owing to the omission of key variables such as fares for example – but one should not simply add fare as an explanatory variable to the models above. Whilst it is true that the variable fare can be a key driver or explanatory variable for capacity, it is also true that capacity, as a proxy for demand, can equally be used to explain the variable fare. This simultaneity between the two variables also known as reverse causality leads to endogeneity. In such an instance, in order to correctly identify the unbiased effect of the variable fare on capacity, an instrumental variable based approach is necessary. Therefore, a weighted Fixed Effects Instrumental Variable (FE IV) approach is proposed below.

Table 22 – Capacity modelling results using Instrumental Variable Weighted FE (IVFE)

Dependent variable	**Log of average seat capacity**	
	Model 1 (Instruments: lags 3 and 4)	Model 2 (Instruments: lags 22 and 23)
Logarithm of average fare	-0.088	-0.314
	(0.028)***	(0.108)***
Malév bankruptcy dummy	-0.063	-0.064
	(0.009)***	(0.010)***
Q2 seasonal dummy	0.146	0.166
	(0.010)***	(0.013)***
Q3 seasonal dummy	0.148	0.162
	(0.010)***	(0.012)***
Q4 seasonal dummy	0.068	0.068
	(0.010)***	(0.012)***
Oil price	0.045	0.050
	(0.014)***	(0.018)***
Constant term	0.08	0.05
	5,012	3,837
R^2	N/A	N/A
N	5,034	3,837
Hansen J test	**0.2003**	**0.0671**
Kleibergen-Paap test	**0.00**	**0.00**
Cragg-Donald Wald F test	**1179.844** (19.93)	**74.742** (19.93)

*Key to table: *p<0.10,* *p<0.05; ** *p<0.01. The p-values of the Hansen J and Kleibergen-Paap tests are presented. The Cragg-Donald Wald F statistics are reported.*

Source: PwC analysis

Note that the instrumental variables or instruments used are the lags of the endogenous variable, in this case the variable fare. As Wooldridge (2008) argues, if a given explanatory variable x is found to be endogenous, then its own lagged values might be used as instruments as they are likely to be correlated with x, the endogenous variable, and unlike x, they will not be correlated with the current period error term, since they were generated at an earlier point in time. A very important caveat here relates to autocorrelated errors. Where the errors are correlated, then the presumed exogeneity or validity of the instruments will be in doubt. As Wooldridge (2008) points out, tests for autocorrelated errors should be conducted and in the presence of autocorrelation, more distant lags might be used to mitigate this concern. Thus, the table above also reports the Hansen J statistic to test the validity of the instruments used. As the coefficients in IV based models are often very sensitive to the lags selected as instruments, two sets of results are reported in the table above.

The above models suggest that the bankruptcy dummy is associated with a 6.3% - 6.4% decline in seat capacity[83]. This coefficient is statistically significant at the 1% level in both models. The models also suggest that a 1% increase in fares is associated with both; a 0.1% decline in capacity according to Model 1 and approximately a 0.3% decline in capacity according to Model 2. Oil price has positive and relatively small effect on capacity. Although small, there is some evidence of the results sensitivity to the choice of lags used as instruments.

As with the fares analysis, to evaluate the robustness of the IV weighted FE model, three specification tests are conducted, which tests for the validity and relevance of the choice of instrumental variables[84]:

- **Hansen J test:** The null hypothesis is that *"the variables chosen are valid instruments of the endogenous variable"*. For model 1, the p-value of the test is 0.20, which means that the null hypothesis cannot be rejected at the 1% significance level, i.e. the choice of instruments is valid. The choice of instruments is also valid for model 2 where the p-value is 0.07.
- **Kleibergen-Paap test:** This tests whether the chosen instrumental variables are relevant or not. The null hypothesis is that *"the variables chosen are **not** relevant instruments of the endogenous variable"*. The p-values of the tests are 0.000 respectively for both models, which means that the null hypothesis can be rejected at the 1% significance level, i.e. the choice of instruments is relevant.
- **Cragg-Donald Wald F test:** This tests whether the chosen instrumental variables are weakly identified or not (i.e. whether these are poorly correlated with the endogenous variable). The null hypothesis is that *"the instrumental variables chosen are weakly identified"*. The Wald F statistics for models 1 and 2 are respectively 1179.8 and 74.7[85] which means that the null hypothesis can be rejected at the 10% significance level[86], i.e. the instruments chosen are not poorly correlated with the endogenous variable.

83 Although at first glance, these results seem to be at odds with table 3 (i.e. capacity has increased after Malév's bankruptcy by 1.3%), this is explained by the fact that table 3 is based on data spanning from February 2011 to January 2013 whereas the econometrics analysis is conducted on data spanning from January 2007 to December 2013.

84 In the field of statistical analysis, a good instrumental variable needs to be both valid and viable. Validity refers to whether the instrumental variables are uncorrelated with the error term of the main fixed effects model. Relevance refers to whether the instrumental variables are correlated with the endogenous variable that you want to instrument for.

85 As shown earlier in this section, the error terms are heteroscedastic (i.e. not i.i.d.). Hence the Kleibergen-Paap Wald F statistic is used instead, which is robust to the presence of heteroskedasticity, rather than the standard Cragg-Donald Wald F statistic.

86 Stata only reports critical values up to the 10% significance level for the Cragg-Donald Wald F test.

Appendix B – Malév elasticity estimation

A2.1 Introduction

Malév Hungarian Airlines, the flag carrier and principal airline of Hungary, was declared bankrupt in February 2012. The main report is concerned with estimating the true impact of Malév's bankruptcy on average fares and capacity.

In addition to estimating Malév's bankruptcy on average fares and capacity, PwC was also asked to estimate the historical income and price elasticities of Malév as part of the econometric analysis. Income and price elasticities are measures used in economics to indicate the responsiveness of the quantity demanded of a good or service to a change in consumers' income or price respectively.

A commonly used approach for estimating elasticities is the 'Almost Ideal Demand System' (AIDS) approach. The rationale for using this model is developed in Section A.2.

The AIDS model was estimated based on three different routes that Malév operated in, i.e. UK, Germany and Italy. The demand model estimates the historical income and price elasticity of demand for the different airline carriers, including Malév, that operate on those routes.

Key results of elasticity of demand

- The preferred model suggests that historically, if consumers' incomes are increased by 1%, consumers' expenditure on Malév increased by approximately 1.2% – 1.6% for the three routes.
- The model also shows that historically, a 1% increase in the price of Malév fares led to an approximate 0.44% – 0.48% decrease in consumer expenditure on Malév for the three routes that were modelled.
- Malév had a relatively high income and price elasticity for the three routes. This suggests that demand for Malév was hit hardest in those routes when consumers' incomes were squeezed during the Eurozone Crisis, and when aviation fares were increased due to higher fuel prices.

A2.2 Demand modelling methodology

The demand model is estimated based on three different routes that Malév operated in (Budapest to UK, Germany and Italy). These three routes were chosen because they had the data required for the estimation of the demand model. The demand model estimates the historical income and price elasticity of demand for the different airline carriers, including Malév, that operate on those routes.

The AIDS (Almost Ideal Demand System) modelling methodology was used to estimate the demand functions. The AIDS model is a system of demand equations rather than a single demand equation estimated in isolation. The primary benefit of this is that the model is consistent with consumer demand theory wherein consumers make decisions among bundles of goods to maximise their use under budget constraint. Other benefits associated with the AIDS model is that it is flexible with regards to the restrictions on how consumers behave, i.e. the model does not impose homogeneity[87]. From a practical stand point, another added benefit of the AIDS model is that it is a less data intensive modelling exercise relative to other methods. It only requires data on

87 Homogeneity restriction implies that if all prices and income are multiplied by a positive constant, θ, the quantity demanded must remain unchanged.

relative prices and expenditure shares although other variables can be added to the model e.g. demographic variables, regional dummy variables.

The AIDS model can be either static or dynamic. The static AIDS model assumes that the demand elasticities are fixed over time. As such, this specification does not account for changes in consumer behaviour (e.g. shifts in preferences for different brands) over time. Although relatively more difficult to estimate, the dynamic model makes a distinction between short and long-run demand elasticities thereby accounting for changing consumer behaviour. The AIDS model is widely adopted in estimating demand elasticities in academic literature (Feleke and Kilmer, 2007[88]; Henneberry and Hwang, 2007[89] Yang and Koo, 1994[90]) This analysis uses both static and dynamic AIDS models to derive own price and cross price elasticities for Malév and competing airlines on three routes (Budapest to UK, Germany and Italy). The demand models can be described as follows:

$$w_{it} = \alpha_i + \beta_i^s \ln(m_t/P_t^*) + \sum_{j=1}^{N} \gamma_{ij}^s lnp_{jt} + \mu_{it}$$ *(Static model – Equation A.1)*

$$\Delta w_{it} = \delta_i \Delta w_{i,t-1} + \tau_i \hat{u}_{i,t-1} + \beta_i^d \Delta \ln(m_t/P_t^*) + \sum_{j=1}^{N} \gamma_{ij}^d \Delta lnp_{jt} + \varphi_{it}$$ *(Dynamic model – Equation A.2)*

Where:

- w_{it} is the market share of airline i at time t on the chosen route;
- m_t is the total expenditure on the chosen route;
- P_t^* is the aggregate price index. In the literature, this price is approximated by the Stone's Price Index as in $lnP_t^* = \sum_{j=1}^{N} w_{jt} lnp_{jt}$. (see Grebner *et al.,* (2010));
- p_{jt} is the price of the fare for airline j at time t;
- μ_{it} is the static model error term;
- $\hat{u}_{i,t-1}$ is the lagged fitted value of the residuals from the static model;
- $\Delta w_{i,t-1}$ is the lagged first differenced market share; and
- φ_{it} is the dynamic model error term.

This analysis uses monthly expenditure and fare data spanning the period January 2008 to February 2012 sourced from the Sabre ADI database. Both the static and dynamic models are estimated using the 'seemingly unrelated regression' procedure (SUR). The SUR approach is a generalisation of a linear regression model which allows for the estimation of a system of individual relationships (i.e. one equation for each airline) each having its own dependent variable and potentially different sets of explanatory variables. The term 'seemingly unrelated' comes from the fact that although the equations look independent from one another, their respective error terms are assumed to be correlated.

88 Feleke, S. T. and Kilmer, R. L. (2007), Analysis of the demand for imported meat in Switzerland using a dynamic specification: Implications for the European Union. Agribusiness, 23: 497–510.

89 Henneberry, S. R., and S. Hwang, 2007. Meat Demand in South Korea: An Application of the Restricted Source-Differentiated AIDS Model. Journal of Agricultural and Applied Economics 39 (1): 47-60.

90 Yang, S. and Koo, W. W., 1994. Japanese Meat Import Demand Estimation with the Source Differentiated AIDS Model. Journal of Agricultural and Resource Economics, 19 (2): 396-408.

When estimating the demand system, two key econometric concerns need to be addressed for the results to be reliable:

- **Firstly,** it is important that variables are stationary, i.e. this means that the variable's mean and variance are constant over time. If a non-stationary variable is regressed against another non-stationary variable, the model may generate spurious results[91].
- **Secondly,** it is important that there is no presence of endogeneity in the model. Endogeneity is always likely to be an issue when estimating demand equations as a change in price can cause a change in sales, and a change in sales can also lead to a change in price. In other words, price is determined endogenously within the model. Also, the dynamic AIDS model includes the lagged first difference market share variable in the specification of the model, and this is by construction correlated with the error term. Explanatory variables in the model need to be exogenous in order for unbiased estimates of price elasticities to be obtained.

These two issues are addressed in turn by:

- The issue of non-stationarity is addressed by testing for co-integration for the variables used in the AIDS model. If variables are co-integrated, then this means that there is some equilibrium relationship shared between the variables with each other that can be leveraged in the estimation of the AIDS model. Cointegration is tested for by using the Johansen test; and
- The presence of endogeneity is tested by using the Durbin-Wu Hausman test. If endogeneity is present in the models, then an instrumental variable approach is used to deal with this.

This is discussed more in detail in Section A.5.

A2.3 Dataset used for the demand model

The AIDS model is estimated based using data on three different routes that Malév operated in (Budapest to UK, Germany and Italy). These three routes were chosen because they had the data required for the estimation of the demand model. The data is monthly data spanning the period January 2008 to February 2012 and is sourced from the Sabre ADI database.

Table 23 and Table 24 respectively shows the airlines that were included in the dataset for each route, and the qualitative description of the variables used in the AIDS model.

A table of descriptive statistics of the data used for the estimation of the AIDS model could be found in

91 A classic example of this is finding a relationship between price levels and the height of a tree each year. A simple regression of one against the other will likely result in a statistically significant relationship. However, this relationship is what economists call spurious, as there is obviously no economic relationship between the two.

Table 32 in Appendix B.

Table 23 – Airlines for each route

Budapest to UK	Budapest to Germany	Budapest to Italy
Malév	Malév	Malév
EasyJet	Germanwings	Italian Airlines
Wizz Air	Lufthansa	Wizz Air
Other airlines that serve this route	Other airlines that serve this route	Other airlines that serve this route

Table 24: List of variables used for the AIDS model

Variable	Description	Units	Source
Airline market share on chosen route	This is the market share in terms of revenue of the airline in question for the chosen route. This is the dependent variable of the AIDS model	%	SABRE-ADI
Airline average fare on chosen route	This is the average fare of the airline in question for the chosen route in USD$.	USD$	SABRE-ADI
Real total expenditure on chosen route	This is the real total expenditure of customers (i.e. revenue earned by airline) for the chosen route. The total expenditure on the chosen route is deflated by Stone's Price Index, defined as weighted average of the airline fares for the airlines that operate on the chosen route, with the weights used being the market share of the airline in terms of revenue.	USD$	SABRE-ADI/PwC generated

A2.4 Model results: Demand model

As discussed in Section A.1, PwC was asked to estimate a demand modelling as part of the econometric analysis. The demand model is estimated based on three different routes that Malév operated in (UK, Germany and Italy). The demand model estimates the historical income and own-price elasticity of demand[92] for the different airline carriers, including Malév, that operate on those routes.

Table 25 shows both the expenditure elasticities and own-price elasticities for the static AIDS model and the dynamic AIDS model respectively. The AIDS model was run for three routes: Hungary to UK, Hungary to Germany and Hungary to Italy. These routes were chosen because these were the three routes that had continuous data for the AIDS model to be estimated.

Table 25: Expenditure elasticity and Marshallian own-price elasticity

	Static		Dynamic	
	Expenditure elasticity	Own-price elasticity	Expenditure elasticity	Own-price elasticity
UK				

92 The Marshallian own-price elasticity reflects both the 'income effect' and the 'substitution effect' of a price change.

	Static		Dynamic	
	Expenditure elasticity	Own-price elasticity	Expenditure elasticity	Own-price elasticity
Malév	1.486***	-0.521**	1.586***	-0.474***
EasyJet	1.321***	0.118	0.876***	-0.178
Wizz Air	-0.186	0.148	0.926***	-0.252**
Others	1.764***	-0.761***	1.033***	-0.255*
Germany				
Malév	0.772***	-0.015	1.151***	-0.444***
German Wings	0.587***	-0.193***	0.476***	-0.192**
Lufthansa	1.210***	-0.279*	1.228***	-0.554***
Others	1.182***	-0.752***	1.076***	-0.554***
Italy				
Malév	1.390***	-0.509**	1.493***	-0.477***
Wizz Air	1.690***	-0.734***	1.014***	-0.368**
Italian Airlines	-0.734	-0.019	1.065**	-0.040
Others	-1.069	-0.967***	0.090	-0.577***

*Legend: ***,**,* denote significance at 1%, 5%, and 10% level, respectively.*

Source: PwC analysis

The reported figures are elasticity figures. The figures in Table 25 are interpreted as follows:

- Expenditure elasticities are interpreted as 'a 1% increase in a consumer's income leads to an x% increase or decrease in the expenditure of the good in question'; and
- Own-price elasticities are interpreted as 'a 1% increase in the price of the good in question leads to an x% increase or decrease in expenditure of that good'.

For example, the static model suggests that historically, for the Hungary to UK route, a 1% increase in consumer's income led to a 1.5% increase in expenditure on Malév routes and a 1% increase in Malév's prices led to a 0.5% decrease in expenditure on Malév routes.

Static AIDS model

All expenditure elasticities for Malév's UK, Germany and Italy routes in the static model were significant at the 1% level. The signs of the expenditure elasticities were all positive – this aligns with expectations, as an increase in a consumer's income should lead to an increase in expenditure for air travel in theory. Both Malév's UK and Italy routes were income elastic (i.e. they both have had an expenditure elasticity greater than 1), and Malév's Germany route was income inelastic (i.e. it has an expenditure elasticity less than 1). This suggests that there were route-specific effects at play here.

The Marshallian own-price elasticities for Malév's UK and Italy routes was statistically significant at the 5% level. The signs of the price elasticities were all negative – this aligns with expectations, as in theory an increase in the price of air travel should lead to a decrease in expenditure for air travel. Both Malév's UK and Italy routes were price inelastic (i.e. they both have a Marshallian own-price elasticity of less than 1). The Marshallian own-price elasticity for Malév's Germany route was statistically insignificant.

Dynamic AIDS model

All expenditure elasticities in the dynamic model for Malév's UK, Germany and Italy routes were positive, income elastic (i.e. expenditure elasticity greater than 1), and were statistically significant at the 1% level. Moreover, results show that:

- All flag or national carriers (i.e. Malév, Lufthansa and Italian Airlines) had expenditure elasticities greater than 1; and
- Expenditure elasticities for almost all LCCs (i.e. EasyJet, Wizz Air and German Wings) were less than 1 (the only exception being Wizz Air for the Hungary to Italy route).

This is interesting because this would suggest that flag or national carriers within the scope of this study were 'luxury goods', i.e. goods where its demand increases more than proportionally to the rise in income, and that LCCs are 'necessity goods', i.e. goods where its demand increases less than proportionally to the rise in income.

In practical terms, this suggests that during the historic period covered in our analysis, expenditure on LCCs increased/declined less than the rate of change in income. Conversely, travelling via flag or national carriers were goods where consumers bought more of when times were good, but also managed to do without during periods of below average income and are often among the first items that got cut when consumers reined in their spending.

All own-price elasticities in the dynamic/short-run model for Malév's UK, Germany and Italy routes were positive, price inelastic (i.e. Marshallian own-price elasticity less than 1), and were statistically significant at the 1% level. Moreover, results show that the Marshallian own-price elasticity was less than 1 for all airline carriers in all three routes in this study, making air travel a price inelastic good. This is perhaps explained by the notion that if a consumer needs to travel, they will generally tend to have less flexibility to postpone or cancel their flight. What is more interesting is perhaps the result that flag and national carriers had higher Marshallian own-price elasticities than LCCs (except for Italian Airlines for the Hungary to Italy route – however, the result for that is statistically insignificant), which again aligns with expectations.

A2.5 Stationarity and endogeneity tests

A2.5.1 Stationarity

As detailed in Section A.1, the issues of stationarity and endogeneity have to be addressed for the results to be reliable. A Dickey Fuller GLS (DF GLS) test was conducted to test for the presence of unit roots. In statistics, a data series is non-stationary if a unit root is present. Table 26 below presents the results of the DF GLS test. The null hypothesis of the DF GLS is that 'there is a unit root in the data series' (i.e. the data series is non-stationary). To interpret the results of the DF GLS test, if the test statistic for a variable is larger in magnitude than the 1% critical value of -3.770, then the null hypothesis is rejected at the 1% statistical significance level, i.e. it does not contain a unit root and is stationary.

It is concluded at the 1% statistical significance level that all of the data series in the AIDS model contain a unit root, and therefore are non-stationary, as all the test statistics do not have a test statistic greater than -3.770 in magnitudes.

Since all the variables used in the AIDS model are non-stationary, this needs to be accounted for by checking whether the variables used in each model contain at least one co-integrating relationship. This is done by using the Johansen test, which tests for the presence of cointegration.

Table 26 – Dickey Fuller GLS unit root test

Route	Variable	DF GLS unit root test statistic
Hungary to UK route	Market share of Malév	-2.537
	Market share of EasyJet	-2.688
	Market share of Wizz Air	-3.290

Route	Variable	DF GLS unit root test statistic
	Market share of Others	-2.949
	Malév fare	-1.763
	EasyJet fare	-1.976
	Wizz Air fare	-2.513
	Others fare	-2.225
	Real total expenditure	-2.430
Hungary to Germany route	Market share of Malév	-2.194
	Market share of German Wings	-1.913
	Market share of Lufthansa	-1.157
	Market share of Others	-3.000
	Malév fare	-2.427
	German Wings fare	-2.214
	Lufthansa fare	-2.083
	Others fare	-1.918
	Real total expenditure	-3.066
Hungary to Italy route	Market share of Malév	-3.340
	Market share of Italian Airlines	-2.026
	Market share of Wizz Air	-2.176
	Market share of Others	-1.529
	Malév fare	-2.891
	Italian Airlines fare	-2.267
	Wizz Air fare	-2.141
	Others fare	-3.327
	Real total expenditure	-3.494

Source: PwC analysis

Table 27 below summarises the results of the Johansen test for cointegration. As the EasyJet model for the Hungary to UK route contains no cointegrating relationships, the results of EasyJet reported in Table 25 should be treated with care.

Table 27: Summary of results of Johansen test for cointegration

Route	Model	Number of cointegrating relationships implied by Johansen test
Hungary to UK route	Malév	At least 1 cointegrating relationship
	EasyJet	0 cointegrating relationships
	Wizz Air	At least 1 cointegrating relationship

Hungary to Germany route	Malév	At least 2 cointegrating relationship
	German Wings	At least 2 cointegrating relationship
	Lufthansa	At least 1 cointegrating relationship
Hungary to Italy route	Malév	At least 2 cointegrating relationship
	Wizz Air	At least 4 cointegrating relationship
	Italian Airlines	At least 1 cointegrating relationship

Source: PwC analysis

A2.5. 2Endogeneity

The second concern with AIDS models is whether the real total expenditure variable is exogenous. If the expenditure variable is correlated with the error term, the regression estimators in the AIDS model may become biased and inconsistent. Endogeneity can usually be corrected for by the use of instrumental variables.

Endogeneity in the AIDS model is tested using the Durbin-Wu Hausman test. The instrument chosen is the lag of the real total expenditure variable.

The null hypothesis of the Durbin-Wu Hausman test is that 'there is no endogeneity in the original model'. If the p-value of the test is below 0.05 (95% significance level), the null hypothesis is rejected.

Table 28: Results of the Durbin-Wu Hausman test

Route	Durbin-Wu Hausman p-value
Hungary to UK	0.001
Hungary to Germany	0.925
Hungary to Italy	0.014

Source: PwC analysis

Table 28 above reports the results of the Durbin-Wu Hausman test on the static AIDS model for all three routes. The Hungary to UK and Hungary to Italy routes have a p-value of less than 0.05. Therefore the null hypothesis of no endogeneity can be rejected on a 95% significance level.

As the null hypothesis is rejected for the Hungary to UK and Hungary to Italy routes, the issue of endogeneity is corrected for by replacing the real total expenditure variable by its predicted value from the auxiliary regression using the instrument. This is chosen as the instrument because it is both a valid and relevant instrument[93]. This is consistent the approach of Henneberry and Mutundo, 2009[94] and Wan, Sun and Grebner, 2010[95], where the issue of endogeneity was found with the real total expenditure variable in the estimation of the AIDS model.

93 To reiterate, in the field of statistical analysis, a good instrumental variable needs to be both valid and viable. Validity refers to whether the instrumental variables are uncorrelated with the error term of the main fixed effects model. Relevance refers to whether the instrumental variables are correlated with the endogenous variable that you want to instrument for.

94 Henneberry, S.R. and J.E. Mutondo. Agricultural Trade among Nafta Countries: A Case Study of U.S. Meat Exports. Review of Agricultural Economics 31(2009):424-45

A2.5.3 Other robustness tests for demand model

Apart from testing for the issues of stationarity and endogeneity, four other robustness tests were conducted on the AIDS models presented in Table 25 above. The description of the robustness tests and their corresponding null hypotheses are described in Table 29 below.

95 Y. Wan, C. Sun and D.L. Grebner. Analysis of Import Demand for Wooden Beds in the U.S.. Journal of Agricultural and Applied Economics, 42,4(November 2010):643-658

Table 29: Description other robustness tests conducted

Robustness test	Description	Null hypothesis
Breusch-Godfrey test	This tests whether the residuals of the exhibit serial correlation. Serial correlation in the residuals means that the residuals of a model are correlated with its past values. Serial correlation of a model's residuals causes the standard errors to be inaccurate, and therefore invalidating statistical significance tests.	There is no serial correlation exhibited in the residuals of the estimated model.
Breusch-Pagan test	This test detects the presence of heteroscedasticity in the residuals of the estimated models. If a residual is said to be heteroscedastic, it means that the variance of the residual is unequal across the sample. Similar to serial correlation, heteroscedastic residuals causes the standard errors to be inaccurate, and therefore invalidating statistical significance tests.	The residuals in the estimated model are homoscedastic.
Ramsey RESET test	This test is a general specification test for the linear regression model, mainly testing for whether the current model contains any non-linearities that it fails to account for. If a model is specified wrongly, this would lead to inaccurate estimates of the model coefficients.	The model is not mis-specified.
Jarque-Bera LM test	This tests whether the residuals of the estimated models are distributed normally.	The residuals are normally distributed, and it exhibits no skewness and no excess kurtosis.

Table 30 below shows the results for the robustness tests. Shaded cells in the table denote instances where the null hypothesis for a test is rejected for a model.

The results of the robustness checks show that the most prevalent problem is the issue of serial autocorrelation in the residuals. Serial autocorrelation in the residuals leads to unreliable estimates of the standard errors and significance tests. Interestingly, the issue of serial correlation is only present in the static models – in fact, nearly all the static models suffer from serial correlation within the residuals with the only exception being the Malév model in the Static AIDS model for the Hungary to UK route. This would suggest that the Dynamic AIDS model performs better in generating residuals that are not serially correlated with each other.

The results of the Breusch-Pagan test show that 16 out of 18 AIDS model have homoscedastic errors, which is a good sign. The results of the Ramsay RESET test shows that 5 out of 18 models is mis-specified, i.e. there are some non-linearities that our model fails to account for. The results of the Jargue-Bera test show that 16 out of 18 models have normally distributed residuals, which is a good sign for model robustness and specification. Our assessment is that these are reasonable conditions for the estimation of the AIDS model.

Table 30: Results of other robustness tests for demand model

		Breusch-Godfrey		Breusch-Pagan		Ramsay RESET test		Jargue-Bera	
		Test statistic	p value	Test statistic	p value	Test statistic	p value	Test statistic	p value
UK – Static AIDS	Malév	2.757	0.100	10.295	0.070	2.002	0.150	1.115	0.570
	Easy Jet	19.529	0.000	9.768	0.080	1.411	0.260	1.871	0.390
	Wizz Air	21.479	0.000	0.418	0.990	1.287	0.290	0.860	0.650
UK – Dynamic AIDS	Malév	2.275	0.130	5.934	0.430	0.061	0.940	0.134	0.940
	Easy Jet	0.824	0.360	6.801	0.340	3.886	0.030	2.067	0.360
	Wizz Air	0.841	0.360	3.911	0.690	3.806	0.030	1.841	0.400
Germany – Static AIDS	Malév	13.780	0.000	13.350	0.020	1.024	0.370	2.015	0.370
	German Wings	11..032	0.000	9.145	0.100	3.186	0.050	0.842	0.660
	Lufthansa	15.752	0.000	11.398	0.040	3.001	0.060	24.637	0.000
Germany – Dynamic AIDS	Malév	0.047	0.830	4.463	0.610	0.119	0.890	95.440	0.000
	German Wings	1.520	0.220	9.533	0.150	0.813	0.450	0.262	0.880
	Lufthansa	0.625	0.430	5.869	0.440	0.357	0.700	1.751	0.420
Italy – Static AIDS	Malév	3.908	0.050	5.929	0.310	3.773	0.030	1.735	0.420
	Wizz Air	20.256	0.000	2.924	0.710	1.124	0.330	1.966	0.370
	Italian Airlines	17.349	0.000	17.110	0.000	11.689	0.000	1.309	0.520
Italy – Dynamic AIDS	Malév	0.048	0.830	2.691	0.850	2.073	0.140	1.796	0.410
	Wizz Air	0.322	0.570	1.389	0.970	0.335	0.720	0.184	0.910
	Italian Airlines	2.400	0.120	9.295	0.160	1.228	0.300	1.528	0.470

Source: PwC analysis

Appendix C – Summary statistics

Table 31: Summary statistics for variables used in the Synthetic Control Method

Variable	Destination Country	No of observations	Mean	Standard deviation	Minimum	Maximum
Seat capacity	Budapest	7,896	4,690	7,357	0	57,015
	Prague	8,531	6,220	8,335	49	61,721
	Bucharest	5,382	6,456	7,493	31	40,906
	Riga	5,019	4,364	4,622	0	30,027
Average distance	Budapest	5,126	1,100	601	198	4,025
	Prague	8,531	1,473	1,362	97	8,332
	Bucharest	5,382	1,286	816	182	7,640
	Riga	4,962	1,428	1,067	159	6,753
Market share of Low Cost Carriers (LCCs)	Budapest	5,126	0.34	0.41	0.00	1.00
	Prague	8,531	0.29	0.46	0.00	1.00
	Bucharest	5,382	0.36	0.48	0.00	1.00
	Riga	4,962	0.89	0.32	0.00	1.00
Total nights spent in hotel or similar accommodation	Budapest	7,896	865,338	479,296	428,721	2,314,649
	Prague	8,531	1705,707	834,059	772,360	3,666,378
	Bucharest	5,382	1299,814	688,545	487,940	3,050,444
	Riga	5,019	94,004	30,367	51,456	177,042

Source: PwC analysis

Table 32: Summary statistics for variables used in the AIDS model

Variable	Destination Country	Airline	No of observations	Mean	Standard deviation	Minimum	Maximum
Airline market share on chosen route	Budapest to UK	Malév	50	0.08	0.02	0.02	0.11
		EasyJet	50	0.26	0.07	0.10	0.39
		Wizz Air	50	0.32	0.10	0.16	0.54
		Other airlines	50	0.34	0.08	0.17	0.54
	Budapest to Germany	Malév	50	0.16	0.04	0.05	0.22
		Germanwings	50	0.20	0.06	0.12	0.34
		Lufthansa	50	0.23	0.05	0.13	0.40
		Other airlines	50	0.41	0.06	0.26	0.54
	Budapest to Italy	Malév	50	0.24	0.07	0.13	0.45
		Italian Airlines	50	0.09	0.05	0.00	0.27
		Wizz Air	50	0.53	0.12	0.32	0.80
		Other airlines	50	0.14	0.07	0.03	0.30
Airline average fare on chosen route	Budapest to UK	Malév	50	114	38	59	192
		EasyJet	50	157	26	109	214
		Wizz Air	50	178	22	114	250
		Other airlines	50	153	34	96	233
	Budapest to Germany	Malév	50	126	26	88	177
		Germanwings	50	128	36	69	222
		Lufthansa	50	151	27	99	208
		Other airlines	50	147	29	116	286
	Budapest to Italy	Malév	50	104	18	61	137
		Italian Airlines	50	99	18	67	139
		Wizz Air	50	115	21	85	173
		Other airlines	50	112	41	54	233
Real total expenditure on chosen route	Budapest to UK	All airlines	50	32,235	5,615	22,281	43,243
	Budapest to Germany		50	32,450	5,223	21,752	42,532
	Budapest to Italy		50	15,702	2,778	8,637	19,509

Source: PwC analysis