PUBLIC-PRIVATE PARTNERSHIPS AND MARGINAL COST PRICING AT AIRPORTS: TWO CASE STUDIES FROM THE RESEARCH PROJECT ENACT

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ABSTRACT

International airports are among the few examples of transport infrastructures which can well achieve self-financing. The growing interest of private companies in airport construction and operation is the visible testimony to this fact. However, the financing structures of airports are complex, involving not only traffic, passenger and goods handling, but also non-aviation services, such as retail, car parking or intermodal facilities. The integration of social marginal cost pricing schemes into this organizational structure according to the strategic plans of the European Commission, however, is challenging. This paper investigates whether they comply with a second strategic policy objective at European and national level, which is to foster public private partnerships (PPPs) in transport financing in terms of full cost coverage, risks and incentives.

The cases analysed in this paper deal with two sites with very different characteristics: Munich Airport which has been publicly operated since 1991 and the Bulgarian airports Varna and Burgas, which have been managed since 2007 by one concessionaire and whose planning and future development is being accomplished with private capital. The results of both cases showed that self-financing is possible in case congestion costs are considered in the SMCP schemes, and given that air traffic growth rates return to the significant levels prior to the economic crisis. The chapter will discuss the legal implications of congestion pricing at European airports which is violating current EC legislation, as well as the impact of alternative pricing schemes on the environmental performance and technological innovation in aviation.

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1 INTRODUCTION

The operation of international airports differs significantly from that of land-based infrastructures, including an extremely high market dynamics, the absence of sunk assets established centuries ago and tax exemptions for all international and many national movements through the Chicago Convention (ICAO 2006). In this environment, international aviation has grown into a mature industry with mainly privatised carriers, largely covering its own operating costs. In general, airlines and airports thus underline a self-financing paradigm, which differentiates them from the above mentioned surface transport infrastructures.

In view of these thoughts, it could be concluded that funding and pricing measures in aviation constitute no major issue for policy or research. But taking into account the state aids paid to the aviation industry, national airlines and airports (EEA 2007 for the European scale, Boss and Rosenschon 2008 for Germany), and in particular to regional ones, the self-financing paradigm of the sector as a whole becomes questionable. It is further remarkable that PPPs to build and extend large international airports are still rare or have failed, as in the case of the German Berlin-Brandenburg International Airport (BBI). Finally, aviation causes considerable external effects globally and in the vicinity of airports.

The paper analyses the impacts of alternative pricing and financing schemes on traffic demand, airport revenues, financial risks and incentives provided by these schemes to airport operators. Specific research questions are:

- Can the revenues of alternative pricing systems cover airport-specific costs, and if not, which alternatives are available?
- Which impacts do alternative prices have on demand and how do they impact congestion and environmental effects?
- Which risks do alternative pricing schemes impose on airport operators and which incentives towards monopolistic profit maximization behaviour need to be considered?

These research questions are discussed for two very different airport locations: firstly, a major international hub in an established and prosperous economic centre of the European Union and secondly, two international airports in the New Member States on the periphery of the Community. In the first case we chose Munich Airport, located in southern Germany, while in the second case we investigate the Bulgarian airports of Varna and Burgas.

The research work was carried out in the research project ENACT funded by the European Commission between 2007 and 2009 (TIS.pt 2010). The paper starts with a short introduction to the ENACT methodology (Section 2), discusses the approach and results for the two locations (Sections 3 and 4) and finally draws conclusions by returning to the research questions (Section 5).

2 THE ENACT PROJECT

The project ENACT - Design Appropriate Contractual Relationships – was funded under the 6th Framework Programme of the European Commission and carried out between May 2007

and December 2009, under the co-ordination of TIS.pt, Lisbon (TIS.pt, 2010). The objective of the project was to explore suitable designs of public-private partnerships (PPPs) in the transport sector and to explore the feasibility and the impacts of social marginal cost pricing schemes (SMCPs) on them.
The ENACT research started by exploring existing knowledge about SMCP and second-best solutions, on contract design, financing schemes and on risk assessment procedures. In a second step, the theoretical findings were used to develop a simulation tool that allowed assessment of the following six case studies. (A): Italian motorways, (B): Tagus river rail crossing, (C): Varna and Burgas Airports, (D): Munich Airport, (E): Lisbon Area motorway concessions and (F): Orkdalsvegen. The primary objectives of the case studies were to identify and analyse implications of SMCP in PPPs and to discuss available alternatives of pricing and PPP design in transport infrastructure operations.
The ENACT Simulation Tool (EST) provides a multi-period framework for estimating investment, operating and external costs and revenues of arbitrary infrastructure assets and service operations. Non-linear congestion and environmental cost functions in conjunction with demand elasticity values allow us to estimate demand risks and profit maximisation functions, enabling the model to calculate incentives for bad behaviour of private operators. A balance sheet functionality finally allows computation of cost coverage indicators and net present values. The EST is implemented in Microsoft Excel to facilitate its application by all project partners and to simplify data input and output procedures.
The subsequent sections summarize the two aviation-related case studies for Munich Airport and for Varna and Burgas Airports by describing their environment, discussing basic transport and economic indicators and presenting the results of the EST.

3 MUNICH AIRPORT

2.1 The Application Case

Munich “Franz-Josef-Strauss” Airport was built between 1980 and 1992. Since its opening for traffic in 1992 the new airport has taken over all business from the historic city airport “Munich Riem”. It consists of two terminals serving two runways, whereby Terminal 2 was constructed and is operated by a joint venture between the airport and Deutsche Lufthansa. With a 5.4 % year-by-year growth in passengers between 1992 and 2007, the airport ranges among the fastest developing ones in Germany and worldwide. With regard to the number of passengers, Munich Airport ranks second in Germany and seventh in Europe (FMG 2009).
The airport is operated by the ”Flughafen München GmbH“ (FMG), a company with limited liability to private law. FMG is 100% owned by the city of Munich (23 %), the State of Bavaria (51 %) and the German federal government (26 %). In the initial phase, the capital owners supported the development of Munich Airport by loan, on which interest is to be paid only in the case of profits, while in periods closing with operative losses interest payments can be transferred to future years.
Actual runway capacity of 90 flights per hour was completely utilized during five hours per day in 2008. Accordingly, a third parallel runway with a size of 4000 times 60 metres to increase hourly capacity to 120 flight movements has been in planning since 2005. Due to the high number of nearly 60,000 legal claims by citizens' organizations and surrounding

communities, it will not be opened to traffic before 2013. The design and construction costs of the runway are estimated to range between € 500 million and € 1 billion.
In 2008, Munich Airport started a three year trial period of charging aircraft landing fees depending on emissions. These can amount to 5 % of total landing fees and are designed to be revenue-neutral to previous landing fees. Other German airports which have introduced the system so far are Frankfurt, Stuttgart and Cologne.
The main focus of the subsequent research is to answer the question whether the respective marginal social cost pricing schemes suffice to fund airport operation and extension and which impacts they have on risks and incentives.

3.2 Demand Projections until 2035

In the Munich Airport case study, annual air traffic movements (ATM) represent the single indicator of traffic demand. Other revenue determining components like aircraft characteristics, passenger and cargo volumes are considered through average load rates, maximum take-off weights, noise levels and air emission factors. Hourly and seasonal fluctuations in demand are taken into account indirectly, by setting delay and congestion values on the basis of detailed flight movement analyses. The base year for the demand forecasts is 2005 and the target year is 2035. Considering the planning horizon of the current planning process for the third runway, 2020 constitutes an important intermediate forecast year.
Until 2020, the official forecast (ITP 2006) considers two cases of demand development. With the current two runways, system capacity would remain at 470 thousand ATM movements per year, which implies the average annual growth rate to be as low as 1.3%. In the case of adding a third runway, capacity would increase to 630 thousand movements, of which 610 thousand movements will be reached in 2020. Starting from 2007 traffic volumes, this implies an annual growth rate of roughly 3.0%.
Within the 30 year forecast horizon we consider none but the planned runway extension, becoming operational in 2013. Although growth rates are mainly limited by the tight airport capacity, latest world air traffic forecasts even before the crises (EUROCONTROL 2009) until 2030 indicate declining growth rates in the medium to long term. It is argued that traffic growth is not evenly distributed in time, due to the increasing maturity of the market, i.e. saturation effects, pressure on ticket prices due to rising oil and CO2 prices and increasing airport and airspace congestion. For Germany, we further assume capacity impacts from extending Frankfurt Airport and opening the new Berlin-Brandenburg International Airport (BBI), demographic impacts and the rise of regional airports limiting future traffic growth at Munich Airport.
For the subsequent analyses of pricing and investment schemes, we distinguish between potential demand from realized demand, which again is differentiated by the variants considered. Potential demand assumes a growth rate of 2.8 % from 2005 until 2020 and 1.8 % until 2035, derived from EUROCONTROL (2009). This results in 793,000 movements or a capacity use of 126 % and thus seriously challenges traffic quality and reliability standards. Realized demand for the various pricing scenarios assumes growth rates of 2.8 % according to current planning documents, and then curbing the growth to 0.5 % in order not to violate capacity limits of 630,000 movements. In addition, two sensitivity variants with low demand

according to the “fragmented world” scenario in EUROCONTROL (2008) and with high demand according to EUROCONTROL’s “global growth” scenario are tested. The resulting annual air traffic movements at Munich Airport are presented in Figure 1.

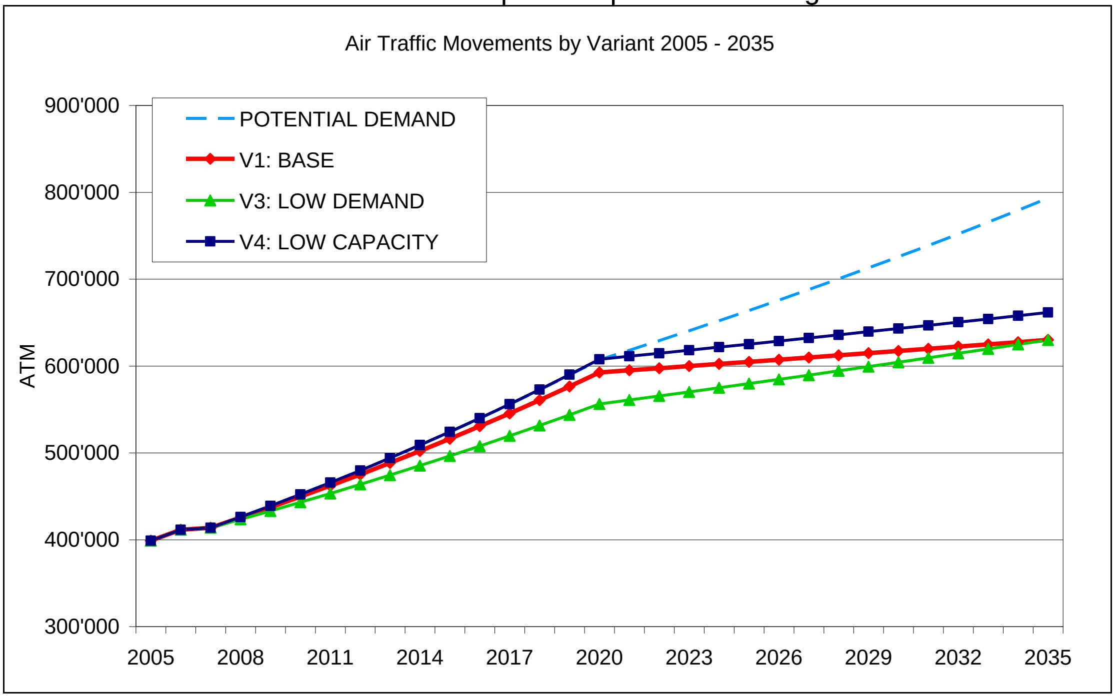

Figure 1: Demand development by variants 2005 to 2035

Source: Estimates by Fraunhofer-ISI

3.3 Evolution of Cost and Revenue Structures

For a proper estimation of airport pricing scenarios and their financial viability, we need to have an idea of airport cost and revenue structures. Ideally, specific information for the aviation and the non-aviation sector (dual till approach) would be required to estimate the social marginal infrastructure costs caused by a single air traffic movement. But this information cannot be retrieved from the airport’s financial services, and therefore we consider the airport as a single utility (single till approach). The only information we have is that, of total revenues, 50% are aviation-related and that take-off and landing charges, which are subject for replacement introducing alternative pricing schemes, contribute less than 30% to the airport’s income. Half of these are currently depending on the aircrafts’ noise categories and, to a much smaller portion, on their emission standards. Table 1 shows Munich Airport's cost and revenue structure in 2008.

Table 1: FMG costs and revenues 2008

Cost category	€ m	Share	Revenue category	€ m	Share
Materials	286,9	26.1%	Landing fees by emissions	6,0	0.5%
Personnel	314,1	28.6%	Landing fees by noise	136,1	12.4%
Depreciation	124,4	11.3%	Other landing fees	173,7	15.8%
Other costs	231,7	21.1%	Other aviation revenues	232,1	21.1%
Associations interest	124,3	11.3%	Non-aviation revenues	495,8	45.1%
Taxes	8,1	0.7%	Other revenues	59,6	5.4%
Profit transfer agreement	9,7	0.9%			
Total	1099,2		TOTAL	1103,3	
Group profit	4,1				

Source: Data from FMG (2009)

In order to estimate long-term trends of airport financial figures, we have made a simple regression of costs and revenues taken from the airport's balance sheets over traffic volumes from 1998 to 2007. The results show a clearly over-proportionate growth of total airport costs and of total revenues with demand. As data availability requires taking the single till approach, we cannot say whether this is solely due to expanding business in the non-aviation sector or also aviation facilities show such increasing costs and revenues to scale. Thus we take the simple assumption that both airport sectors develop proportionally. Landing and take-off charges, which are later replaced by alternative pricing schemes, are assumed to have a fixed share of 30% of total revenues. On top of these we have added the capitalised investment and operation costs of the third runway.

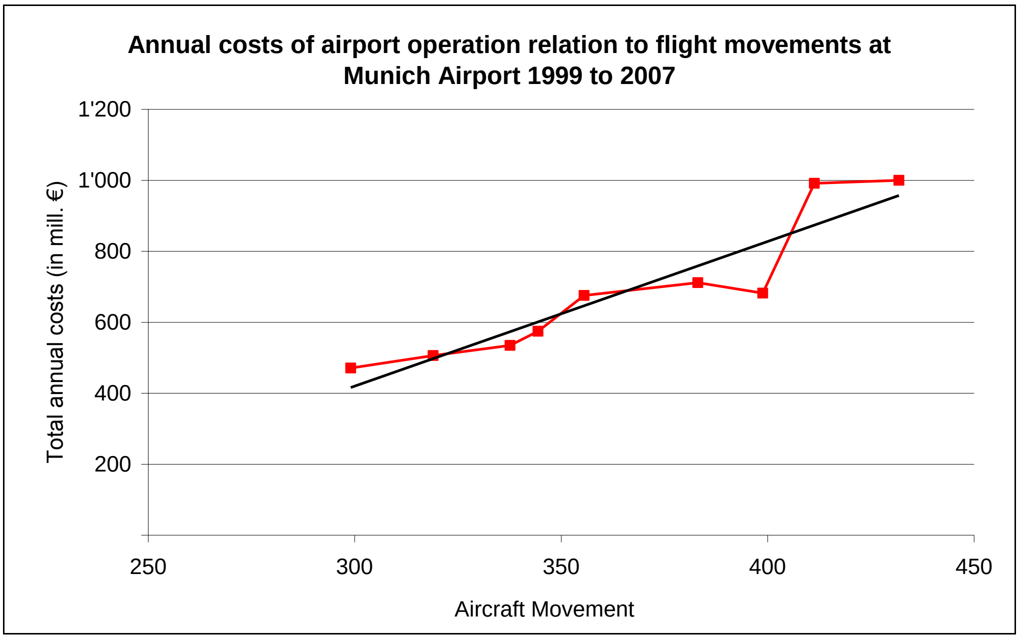

Figure 2: development of total costs and revenues with ATM from 1999 to 2007

Source: Compilation using data from FMG (2008) and earlier editions

3.4 Alternative Pricing Schemes

The revenues to be replaced by marginal social cost pricing fees are those charged to airlines for landing and take-off. We limit the scope of this research to the marginal social costs of infrastructure use, congestion, air pollution and noise. Air accidents are disregarded as they are to a great extent influenced by air traffic management and can thus hardly be controlled by airport regulations. Accordingly, the security-related costs of public authorities at airports and of air traffic control are ignored. Climate costs are not considered because the upcoming inclusion of air traffic in the European Emissions Trading System will internalize this social cost category. Finally, ground handling is ignored here, as it is regulated by handling companies on the basis of the EU Ground Handling Directive 96/97EC (EC 1996).

Marginal social infrastructure costs are considered in two variants: short-run costs for maintenance and repair measures directly attributable to aircraft movements, and long-run costs which take account of the capacity demand of each movement, and thus of its responsibility for capacity extension needs. Both variants of infrastructure costs are estimated using the results of the GRACE case studies (GRACE 2006). Here, short-run infrastructure costs have been derived from time series of total annual costs and flight movements at Munich Airport, while long-run marginal infrastructure costs are estimated by cross airport regressions for a particular year. Translated into air traffic movements, GRACE (2006) arrives at short-run infrastructure costs of roughly € 290 and long-run costs of around € 640 per ATM. GRACE also follows the single till approach, but differentiates costs into ATM-related and passenger-/cargo-related shares. Here we apply the 30%-rule to the latter segment in order to eliminate non-aviation-related social marginal infrastructure costs. While the resulting long-run marginal costs cover actual average landing fees by at least 89 %, short-run marginal infrastructure costs amount to only 40 % of current revenues. For future development we assume that short- and long-run costs per movement increase by 1 % each year, due to bigger aircraft to be accommodated by the airport infrastructure.

Marginal external congestion costs have been estimated, based on flight volume and delay relationships observed from Munich Airport's web site, supplemented by airport statistics (FMG 2008b), records of the Association of European Airlines (AEA 2008), and Eurocontrol information (EUROCONTROL 2007). Flights and delays at Munich Airport were observed during two months in December 2007 and February 2008. With airline cost values of € 5,000 per flight and € 1,500 for passengers, according to UNITE (2002), these observations led to marginal external delay costs per additional flight in peak hours of € 470. Taking into account that some of these costs are internalized by the airlines, as big hub carriers delay their own flights (NERA 2004), and assuming a comparably high share of weather-inflicted delays in the observation period, we estimate marginal external congestion charges in peak hours at Munich Airport of € 240 per flight. For the development until 2035, we assume an increase in aircraft sizes between 8 % and 10 % and additional flight movements per hour between 16 % and 27 %, leading to a growth in average delays between +20 % in the low demand variant and +50 % in the high demand. Accordingly, congestion charges in 2035 are estimated as being between 52 % and 106 % above 2005 levels. Finally, it should be noted that for theoretical reasons congestion costs must not be charged when raising long-run infrastructure charges, as both charge for the potential costs of capacity extension.

The charges for environmental external costs for air pollution and noise are set according to the handbook on the estimation of external costs issued by the IMPACT study (IMPACT 2008). Average values are € 45 for air pollution and € 150 for noise. Within the coming 30 years, we assume that technological progress, more rigid emission regulations and the intensified application of pricing instruments put considerable pressure on the industry to reduce the harmful impacts of aircraft. By comparing the actual fleet with the technical standards now available, we estimate a decline of noise costs by 50 % and air pollution costs by 40 % per flight movement until 2035.

3.5 Scenarios and Results

The case of reforming Munich Airport's landing and take-off charging system according to the pricing policy advocated by the European Commission was analysed with the help of the ENACT Simulation Tool (EST). With the cases of demand development and the options of combining marginal social cost prices for infrastructure use and for congestion, we have formulated a reference case plus four scenarios, varying pricing in regimes and demand development.

- Reference scenario: in this case we assume the third runway will be opened for traffic in 2013, but no change in the airport's pricing regime. ATM develop according to the base demand scenario
- V1: BASE. As the reference case, but replacement of the current landing and take-off fees by marginal social costs by short-run infrastructure and congestion charges.
- V2: LRMC. As BASE, but replacement of short-run infrastructure and congestion charges by long-run infrastructure charges.
- V4: DEMAND. As BASE, but with ATM developing according to the fragmented world scenario
- V5: CAPACITY. As BASE, but with demand developing according to the global growth scenario

Figure 3 presents the resulting development of marginal cost pricing systems in the Variants V1 to V5 now and in 2035. Given the stable increase of air traffic movements from 2005 to 2035, plus the discussed growth in marginal cost tariffs in the same period, there will be a significant increase in revenues over the coming 30 years. With an average growth rate of 2.5 % in ATM, and around 3 % in MSC charges, we receive an annual growth rate of roughly 5.5 % in annual revenues.

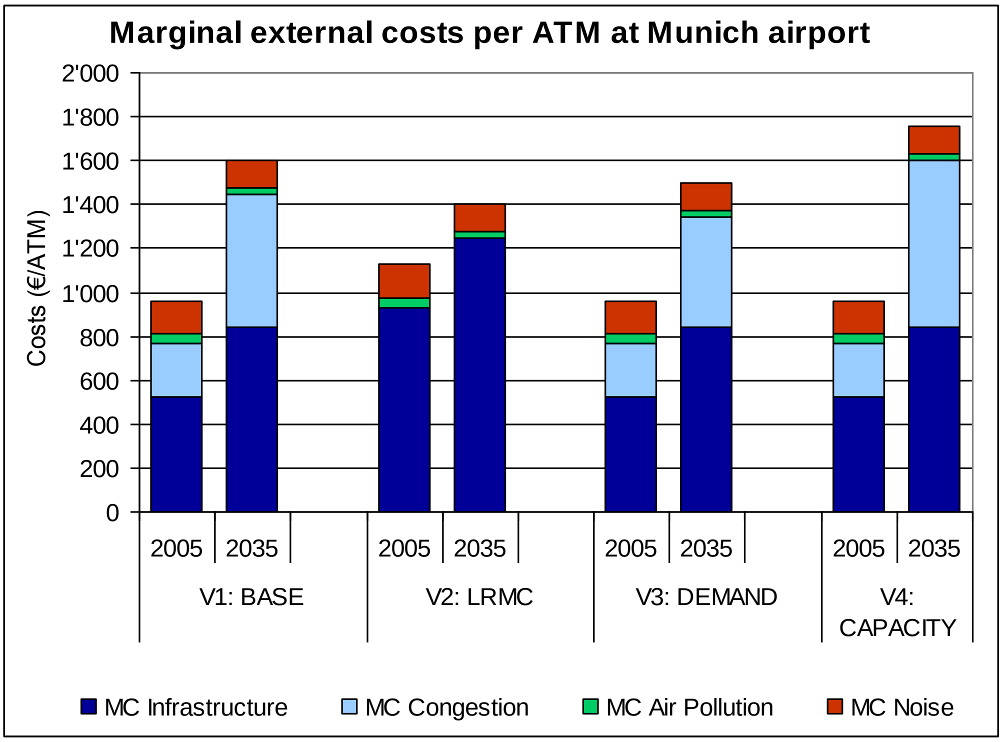

Figure 3:Structure of marginal costs by variant and cost category 2005 and 2035

Table 2 summarizes the key output parameters of the ENACT Simulation Tool for the four variants. Empty fields either indicate variables which are not computed by the tool due to specific parameter constellations or computations omitted by the authors.

Compared to predicted airport operating costs, all four variants appear to be financially viable but are associated with higher risks than conventional pricing schemes. However, the figures also show that in all four cases SMCP revenues are below the revenues of the current pricing scheme. The discrepancy is particularly high in variant 3 – Low Demand. Here the difference to the actual case is € 314 million in present value, i.e. well above € 10 million per year, amounting to roughly 4% of annual turnover in the aviation sector. Acknowledging the high insecurity associated with long-term cost and revenue forecasts, the financial viability of the alternative pricing regimes becomes highly questionable.

Revenue risks are estimated taking the principal volume-delay function sketched by DLR (2007) for commercial airports concerning congestion revenues into consideration. The elasticity of MSCP revenues with respect to changes in demand is reported, ranging between 4.37 (Variant 4) and 5.04 (Variant 5) when congestion charges are included. This means that a 1 % change in demand implies a roughly 4.7 % change in MSCP revenues. These elasticities are very high and imply a high revenue risk or insecurity for the airport operator when prices are strictly set according to marginal external costs. In case congestion costs are excluded, as in Variants 2 (LRMC) or congestion levels are low, as in Variant 3 (LO DEMAND), revenue elasticity to demand is close to unity. No specific revenue risk on top of the demand risk exists in these cases, which makes them more attractive to risk-averse investors.

Table 2: Results of the ENACT Simulation Tool for Variants 1 to 4

Cost/revenue category	Unit	Variant 1 BASE	Variant 2 LRMCP	Variant 3 LO.DEM.	Variant 4 HI DEM.
MSCP Revenues					
Total (NPV) 1)	€ m	21,188.8	20,591.0	20,211.3	20,972.6
Infrastructure	share	40.2%	75.4%	40.9%	35.9%
Congestion	share	37.7%		36.7%	44.4%
Air pollution	share	4.6%	5.2%	4.7%	4.1%
Noise	share	17.4%	19.5%	17.7%	15.6%
Financial & Risk Analysis					
PV MSCP, no RP 1)	€ m	258,9	-338,9	247.5	10,008.9
PV MSCP, RP (MSCP) 1)2)	€ m	180,0		171.0	932.3
RP (MSCP) 2)	€ m	78,9		76.6	76.6
RP (MSCP) / RP (conv.) 2)	ratio	109.8%		109.7%	109.7%
Mark-up to cost recovery 1)	€/ATM	0.0	20.0	0.0	0.0
Incentives Analysis 3)					
Actual Capacity	ATM/d	1726			
PMC Capacity	ATM/d	1847			
Revenue increase with PMC		1.0%			
Incentives to perform well		Adequate			

Notes: 1) Net present values with 6% interest rate p.a. – 2) only computed by EST with congestion costs – 3) evaluated for variant 1 only
Source: Fraunhofer-ISI

3.6 Impacts on Risks and Incentives

Air traffic volumes, and thus the income of airports, are very sensitive to external factors, such as world economic development, sabotage like the terrorist attacks of 9/11, strikes, fuel costs or the economic performance and business models of airlines. The conditions for airports become even more difficult as airlines push towards shifting more fees from fixed tariffs based on aircraft weight, into variable, passenger-dependent elements. We thus assume a relatively high risk premium under current pricing conditions of 10%.
For all variants charging for congestion costs,
Table 2 reports a risk premium which is roughly 10% above the conventional premium. Although the expected differences to the current system of airport charges are not big, the transition to marginal social cost prices leads to a more risky and less profitable situation. Taking this increased revenue risk into account reduces the net present value (NPV) for the BASE and LO DEMAND variants by roughly 30 %.
But it must be emphasised that these figures still do not take into account the congestion solved by the several air traffic control entities in the airspace. To get the full picture of demand and capacity risks in the aviation sector, the airports should thus be considered jointly with the air traffic management for flights approaching and leaving the airport. The current setting delivers only a partial picture of the true conditions and inter-relations.
Eventually, financial risks external to the airport operator arise from investment decisions at competing locations, namely Frankfurt and, to a lesser extent, the new Berlin-Brandenburg International Airport (BBI). A considerable delay or cancellation of the third runway at Munich

could change the hub concept of Lufthansa and its alliance partners with drastic implications for Munich's financial results.
In the incentives analysis, the EST searches for the level of infrastructure capacity which would maximise the infrastructure manager's profit, generated either by increasing congestion revenues or by additionally attracting demand. In the current case of Munich Airport, this profit maximizing capacity (PMC) is found to be well above current capacity for all four variants.
The computed additional capacity ranges around 28 % above current capacity, which would justify a fourth runway. In other words, under the assumptions taken, the airport operators are not expected to have any incentives to artificially shorten capacity to increase congestion revenues. Until 2035, this additional capacity is expected to meet potential demand increases which could be attracted by the airport in the absence of capacity limitations. The potential slow-down of future market growth rates, however, will most likely ease the problem of infrastructure scarcity at Munich Airport occurring, despite investment in the third runway.

4 THE CONSTRUCTION OF VARNA AND BURGAS AIRPORTS

4.1 The Application Case

The airports Varna and Burgas serve the Black Sea region and mainly the international tourist traffic, which is generated principally in the summer months (June, July and August). The basis for the traffic growth is the intensive tourist business development, with its high seasonal profile. Traffic is determined by the demand of generalized tourist service products. Airport charges have an insignificant share in the aggregate price of the product. There is no possible alternative mode of transport to serve the International tourist traffic.
This case study considers the pre-history of the concession procedure of Burgas and Varna airports, the granting of the concession, the nearly 2-year term of operation of the concessionaire, as well as the predicted results of the concessionaire's activity in the period 2009 - 2041.
Based on the analysis of international experience with airport operation, the Bulgarian government accepted a strategy for developing and modernizing Burgas and Varna airports and also a public–private partnership (PPP) as the most appropriate form of concession. The concession procedure started in 2003 and was completed after approx. 40 months due to appeals by the other candidates. With the choice of concessionaire as operator of both airports - the shareholder company Fraport Twin Star Airport Management (capital shares are 60 % FRAPORT AG Frankfurt Airport Services Worldwide, Germany and 40 % “BM Star" Ltd., Bulgaria), the concession started at the beginning of 2007.
The contracted parameters of the concession (Burgas and Varna Airports) are: a concession term of 35 years, concession state remuneration (concession fee) including initial payment of concession tax of € 3 million, and annual state remuneration payment to the government implemented twice a year in the amount of 19.2% of the generated revenues of all activities, both regulated (54 - 56 %) and non-regulated (44 - 46%).

The main problems in relation with the capacity of both airport terminals arise during the summer months (June, July and August), as during that period they serve about 70 % of the annual passenger demand and 60 % of annual aircraft movements In the long run. The long term.forecasts show a stable aviation traffic increment. The fact that in the last few years the Bulgarian Black Sea resorts have been overpopulated creates a potential risk that the growth rate of tourist traffic will decrease. However, the trend towards the increase in the share of the regular internal flights is positive.

The concession contract determines the allocation of risks between the two parties, the concessionaire and the government. All important risks connected with investments and construction, management and exploitation or commercial activities are assumed by the private party. The ownership, especially of the fixed assets, is not given to the concessionaire. The concessionaire is obliged to invest the amount of € 403 million in both airports during the concession period. This fact predetermines that the concessionaire faces a high investment risk which is very sensitive to travel demand. To ensure full coverage of operating and investment costs, it is thus favourable from the concessionaire's perspective that travel demand is inelastic to increments of airport charges.

4.2 Demand Projections until 2035

The airports Burgas and Varna are both managed by one concessionaire, Fraport Twin Star Airport Management. The initial year for the case study is 2007, which corresponds to the start of the public-private partnership (PPP). The long-term horizon matches the 35-year period of the concession, i.e. till 2041.

Traffic forecast data for Varna and Burgas Airports are retrieved from the elaborated master plans in three scenarios – base trend, optimistic and pessimistic scenarios. As a result of the recent world economic and financial crisis, compared with the forecast in the base scenario (given in Burgas airport master plan), there is a certain delay related to the forecast in 2008. This gives us reason to assume the forecasting of the pessimistic scenario (Figure 4 to Figure 6) where in 2008 there are about 2 million passengers. Consequently, further sensitivity or reaction of the model will be investigated in relation to the pessimistic scenario of the forecast.

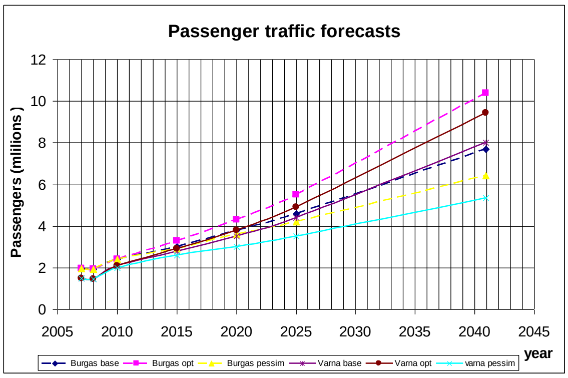

Figure 4:

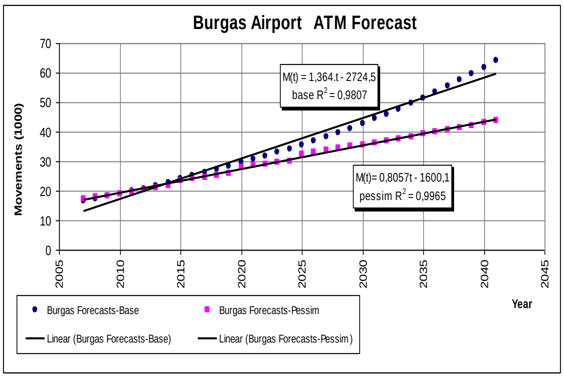

Figure 5

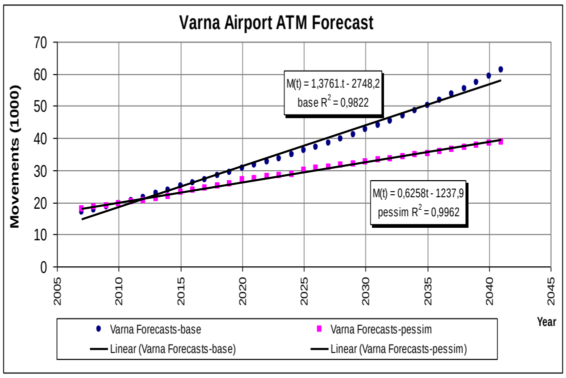

Figure 6

Since the study was carried out in 2008, obviously it does not report the additional drop in passengers and movements for 2009. Finally, regression equations enabling movements to be forecast are established for three different scenarios as presented in Table 3:

Table 3: Movement forecasts (Varna and Burgas airports)

Scenario	Airport	Total Movements M(t) = Mo.(1 + a.t)
Base Trend	Burgas	M(t) = Mo.(1 + 0,058.t)
	Varna	M(t) = Mo.(1 + 0,056.t)
Optimistic	Burgas	M(t) = Mo.(1 + 0,075.t)
	Varna	M(t) = Mo.(1 + 0,063.t)
Pessimistic	Burgas	M(t) = Mo.(1 + 0,047.t)
	Varna	M(t) = Mo.(1 + 0,036.t)

Note: Mo = Movements (2007) and t – year.

4.3 Evolution of Cost and Revenue Structures

The general structure of revenues is 54 – 55 % in regulated activities (passenger, landing and aircraft parking charges) and 45 - 46 % in non-regulated activities (ramp, passengers and cargo services, fuel loading, catering and commercial). The general structure of costs is 60 - 62% in regulated activities (including 19,2 % of revenue concession fee) and 38 - 40% in non-regulated activities. The total costs and revenues of both airports Varna (42 % of revenues, 45 % of costs) and Burgas (58 % revenues, 55 % costs) for 2008 are given in Table 4.

Table 4: Costs and revenues 2008 (Varna and Burgas airports)

Cost category	M€	Share	2008/2007	Revenue category	M€	Share	2008/2007
Materials	2,3	7,1%	-10,4%	Aviation (landing and Pax fee)	21,9	53,9%	-1,4%
Personnel	12,1	37,3%	-17,0%	Other aviation revenues	13,2	32,5%	-8,3%
Depreciation	3,9	12,0%	28,7%	Non-aviation revenues	5,5	13,6%	13,0%
Other costs	4,5	14,0%	24,5%	Other revenues	0,02	0,1%	
Concession fee	7,8	24,2%	-1,5%				
Interests	0,8	2,5%	42,5%				
Taxes	0,9	2,9%	-4,7%				
TOTAL	32,3		62,2%	TOTAL	40,7	100,0%	
Net Profit	8,3						

On the basis of the detailed investment plan for the 5-year period (2007 – 2011) and of the predicted demand for the whole 35 year concession period, the values of the cost and the revenues from the separate groups are forecast. Financial costs forecasts are implemented on the basis of liabilities variation modelling. The variation of the liabilities depends on the forecasted total investments and cash flow after equity increment, loans from shareholders,, long-term credits and their debt amortization plans have been taken into account.

Profit taxation values are determined with the following assumptions: 10% rate of profit taxation and depreciation costs based on depreciation rates of different assets. Subsidies are used with a negative sign within the EST to report the paid by the concessionaire concession fee forecasted as 19.2 % of the total revenues from regulated and non-regulated activities.

4.4 Alternative Pricing Schemes

The alternative pricing scheme is based on the analysis of the social marginal cost pricing schemes to generate sufficient revenues and at the same time to be financial viable. The main marginal costs considered in the research are infrastructure, congestion, air pollution, global warming and noise costs. Accident costs are not taken into consideration.

In the present case, 8 scenarios were elaborated for each of the two airports, with expressed differences in several aspects: traffic level – base and pessimistic, infrastructure costs short-run marginal costs (SRMC), long-run marginal costs (LRMC), with aviation and non-aviation costs and revenues considered separately. Considered scenarios are presented in the table below:

Table 5: Pricing variants and demand scenarios

Considered Scenarios			
Airport	**Marginal Costs**	**Revenues and Costs**	
		Base Demand	**Pessimistic Demand**
Varna	**SRMC**	**V.1.1**	**V.2.1**
	LRMC	**V.1.2**	**V.2.2**
Burgas	**SRMC**	**B.1.1**	**B.2.1**
	LRMC	**B.1.2**	**B.2.2**
Revenues and Costs - Aviation/Non-aviation separated			

Two different cases of values were assumed for infrastructure costs: average operating costs per movement excluding depreciation are representing short-run marginal costs (SRMC), while long-run marginal costs (LRMC) are determined by the average operating costs per movement, including depreciation based on the investment profile during the concession period. These values are taken in both the base trend and in the pessimistic scenarios.

The main assumptions are an inflation rate of on average 5.0 % for the period 2007 - 2011 and on average 2.0 % after 2011 per year and a nominal discount rate of 8.1 %, corresponding to a real discount rate of 6.0 %).

On the basis of the income statements forecasts for 2007 - 2011 and projection of their values for the whole concession period, we approached to the main average values per movement (2007) and growth rate factors (2007 – 2041) by airports and scenarios (Table 6).

Table 6: Costs and revenues 2008 (Varna and Burgas airports)

Airports	Scenarios	SMC	Values (2007)	Growth Rate (2007 - 2041)
Burgas	**Base Trend**	**SRMC**	**598**	**1.83 %**
		LRMC	**679**	**2.39%**
	Pessimistic	**SRMC**	**574**	**1.99 %**
		LRMC	**651**	**2.89 %**
Varna	**Base Trend**	**SRMC**	**612**	**0.78 %**
		LRMC	**698**	**0.62 %**
	Pessimistic	**SRMC**	**573**	**1.04 %**
		LRMC	**653**	**0.98 %**

The time delays per aircraft movement have been estimated by creating a delay cost function, which takes into account the impact of the seasonal character of demand. It can be seen in Figure 7 that there is a high monthly fluctuation in the number of movements that could be ascribed to the seasonal character of the traffic.

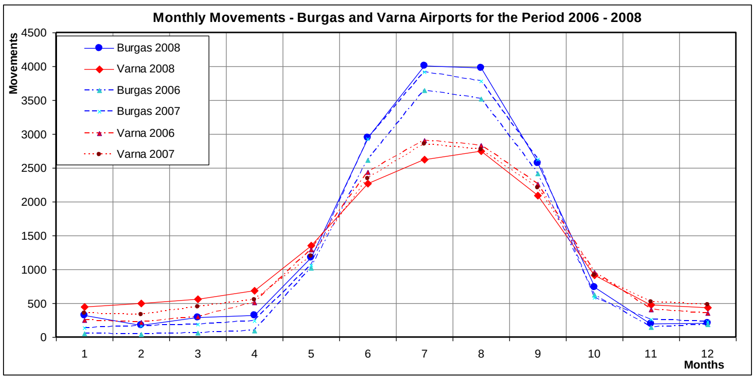

Figure 7: Monthly Movement Traffic 2006 – 2008 - Varna and Burgas Airports.

Source: Fraport

On the basis of the above, three periods in the year characterizing the traffic level can be fixed:

- Peak period which is 3 months long (June, July and August) when for the separate years the total number of movements for both airports varies from 57.9 % up to 61.6 % of all movements, and the demand from 70.4 % up to 71.4 % of summary yearly demand;
- Medium periods – in the months May and September when for the separate years the total number of movements for both airports varies from 22.4 % up to 24 % of all movements, and the demand from 21.6 % up to 22.9 % of summary yearly demand;
- Non-peak periods in the other 7 months (1-4, 10-12) when for the separate years the total number of movements for both airports varies from 14.4 % up to 19.6 % of all movements, and the demand from 6.6 % up to 7.4 % of summary yearly demand.

According to the data above, the greatest demand and capacity utilization of the airports are observed during peak months due to tourist trips. The expansion process of airport terminals and capacity increment till 2008 is accompanied with the realization of costs because of delays. If there are delays, they only occur at the peak periods since at this time the demand value approaches the capacity figure. Delay cost shares are highest in these months. That is why in off-peak periods there are actually no delay costs, or if they do occur, they are negligibly small. Therefore determining annual delay costs necessitates the creation of a function to describe the relationship between the average yearly delay to service time ratio, depending on the movements and the capacity. With this target in view we created a function based on the following assumption: the function has to report the annual fluctuation of capacity utilization, i.e. reflect the fact that actual delay costs are generated during the peak period and for the remaining periods of time – medium and non-peak – the delay costs share can be ignored. The function is established on the basis of the 3 month peak period. Multiplying the average month demand at peak period by twelve, we arrive at an equivalent one-year demand.

Congestion cost function determination is accomplished after applying the model of a runway considering it as a queuing system of type M/G/1.

Generally, we can approach the function that describes the marginal congestion costs depending on the total annual delay expressed in minutes per year, multiplied by the value of 1 minute delay determined for the appropriate year. Then the marginal congestion cost per LTO *Ccong(t)* can be determined using the following formula:

Equation 2: $$C_{cong}(t) = k_w \frac{Z_t . t_{serv}}{LTO_t} . C_{del} .(2006). Inf_{Ac}(t) \quad ,$$

where: *LTOt* – number of landing and take-off cycles;

C_{del} – value of 1 minute delay;

$Inf_{Ac(t)}$ – cumulative inflation factor towards 2007 year;

Zt – total yearly delay S_y to average for runway service time t_{serv} per movement ratio and based on the value for the practical hourly maximal capacity Cap_h = 35 movements per hour;

k_w – 0.58 with accepted coefficient of variation of service time C_s = 0.4.

Based on the value of C_{del} = 72 €/min for ATM delay (EuroControl, "Standard Inputs for Eurocontrol Cost Benefit Analyses" 2005 Edition) that is given in € at 2004 price levels, the value of 1 minute delay has been inflated from the value of an inflation rate of 2.2 % in 2005 and 2.2 % in 2006. So the value calculated for 2006 became equal to C_{del} = 75 €/min.

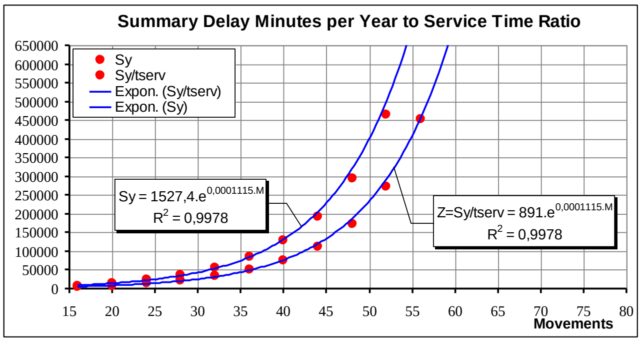

Figure 8:Total Delay to Service Time Ratio.

The congestion cost for each scenario is achieved by multiplying the marginal congestion cost per LTO *Ccong(t)* by LTO in year *t*.

Concerning global warming, the status is that we have forecast values and estimates for the CO_2 and NOX emissions released in the atmosphere. Actually, there is no specialised cost taxation of global warming in the operating concession and no cash flow is allocated to funds in this area. Taxes are structured depending on aircraft weight and per passenger and do not depend on the aircraft engine type. Since transforming some measure units to others is comparatively difficult, and the global warming costs share of total costs is insignificant, we followed the same approach as that taken in the Munich case. So we used the same values, but translated them with the following equations to determine air pollution and noise costs for year *t*:

Equation 3: $CAP = 43.8.(1 - 0{,}013.(t - 2007));$

Equation 4: $CN = 145\ (1 - 0{,}167.(t - 2007))$

The investment forecast is based on the anticipated total sum in the concession contract for investments in both airports that amount to € 403 million (45 % for Varna and 55 % for Burgas) for the concession period. Also included are their development master plans till 2025, approved according to the clauses of the concession contract by the Minister of Transport, forecast costs and revenues reports for the period 2007 – 2011 and balance sheets, and the concessionaire's costs and revenues reports in 2007.

Investments are subdivided into construction and planning (terminals, runway and other technical facilities) and equipment acquisition.

The forecast investment figures for both airports depending on the investment period and on the type of investments are shown in the table below.

Table 7: Investment plans (2007-2041)

Investments (€million)	Airport			
	Varna		Burgas	
	Construction and Planning	Equipment Acquisition	Construction and Planning	Equipment Acquisition
Immediate and intermediate improvements (2007 - 2011)	48,348	16,775	55,260	17,511
Long term investments (2012 - 2021)	31,898	13,735	34,398	16,229
Long term investments (2022 - 2041)	50,957	26,070	48,447	43,521
Total investments:	131,203	56,580	138,105	77,261

The profile of investments for the life time cycle of the concession for both airports is given in Figure 9 and Figure 10.

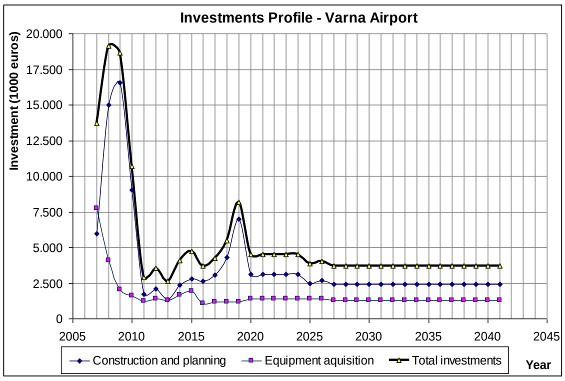

Figure 9: Varna Airport Investments Profile

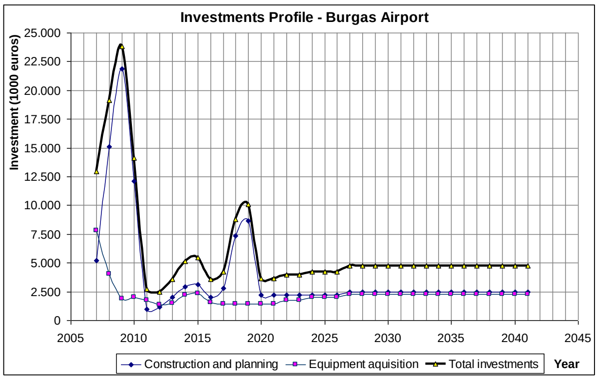

Figure 10: Burgas Airport Investments Profile

4.5 Scenarios and Results

The study on Varna and Burgas airports, summary of the key output parameters of the ENACT Simulation Tool concerning the 4 scenarios for each of the airports Burgas and Varna - base (SRMC and LRMC) and pessimistic demand (SRMC and LRMC) is given in Table 8 and Table 9.

Table 8: Burgas Airport - Output Results from ENACT Simulation Tool for Scenarios

Airport Burgas		**Scenarios**			
		Base Demand		**Pessimistic Demand**	
Costs/Revenues	**Measure Unit**	**B.1.1 SRMC**	**B.1.2 LRMC**	**B.2.1 SRMC**	**B.2.2 LRMC**
Financial Evaluation Results					
Discount Rate	% Nominal	8,1	8,1	8,1	8,1
NVP SMCP	K€	16.930	64.050	-20.720	26.400
NVP SMC, RP conv.	K€	9.264	55.443	-26.752	19.426
NVP SMC, RP SCMP	K€	2.531	48.710	-32.385	13.793
Feasibility of MSCP		YES	YES	NO	YES
Required Price Markup	€/Movement	-	-	30,339	-
Excess Revenues	M€	2.531	48.710	-	13.793
Balance Sheet					
Costs					
Total Costs(SMCP)	K€	-360.780	-360.780	-316.894	-316.894
Total Costs(Actual)	K€	-374.975	-374.975	-326.916	-326.916
incl. Other Costs	K€	-59.526	-59.526	-49.124	-49.124
Revenues					
Total Revenues (SMCP)	K€	377.710	424.830	296.173	343.294
Total Revenues (Actual)	K€	450.107	450.107	361.716	361.716
SMC Pricing (with Actual Demand)	K€	383.264	430.384	301.592	348.712
User Charges (Actual)	K€	455.460	455.660	367.134	367.134
Concession Fee	K€	106.956	106.956	85.952	85.952
Other Type of Revenues					
Asset Residual Value	K€	0	0	0	0
Other Revenues	K€	101.402	101.402	80.534	80.534
CASH FLOWS (in k€)					
Cash Flow (SMCP)	K€	16.930	64.050	-20.720	26.400
Cash Flow (Actual)	K€	75.132	75.132	34.800	34.800
Risk Evaluation					
risk of lower than expected revenues					
E(D) - std(D)	%	-10,0%	-10,0%	-10,0%	-10,0%
E(D) + std(D)	%	10,0%	10,0%	10,0%	10,0%
risk premium of demand based revenues					
Conventional Risk Premium	% of Revenues	2,0	2,0	2,0	2,0
Difference between SMCP and Conventional Pricing Scheme	% of Revenues	1,76	1,56	1,87	1,62
	K€	6.733	6.733	5.633	5.633
Incentives Analysis					
Actual Capacitiy	ATM/Day	700	700	700	700
PMC Capacitiy	ATM/Day	462	462	351	351
Increase of Revenues with PMC	%	105	102	290	275

Source: ENACT Simulation Tool

Table 9: Varna Airport - Output Results from ENACT Simulation Tool for Scenarios

Airport Varna		**Scenarios**			
		Base Demand		**Pessimistic Demand**	
Costs/Revenues	**Measure Unit**	**V.1.1 SRMC**	**V.1.2 LRMC**	**V.2.1 SRMC**	**V.2.2 LRMC**
Financial Evaluation Results					
Discount Rate	% Nominal	8,1	8,1	8,1	8,1
NVP SMCP	K€	26 704	65 892	-16 450	22 737
NVP SMC, RP conv.	K€	20 497	58 901	-21 068	17 336
NVP SMC, RP SCMP	K€	14 010	52 414	-	-
Feasibility of MSCP		YES	YES	-	-
Required Price Markup	€/Movement	-	-	-	-
Excess Revenues	M€	14010	52414	-	-
Balance Sheet					
Costs					
Total Costs(SMCP)	K€	-282 705	-282 705	-245 841	-245 841
Total Costs(Actual)	K€	-298 883	-298 883	-262 505	-262 505
incl. Other Costs	K€	-47 757	-47 757	-38 445	-38 445
Revenues					
Total Revenues (SMCP)	K€	309 410	348 597	229 391	268 579
Total Revenues (Actual)	K€	314 356	314 356	240 325	240 325
SMC Pricing (with Actual Demand)	K€	310 352	349 539	230 884	270 071
User Charges (Actual)	K€	315 298	315 298	241 818	241 818
Concession Fee	K€	74 698	74 698	57 107	57 107
Other Type of Revenues					
Asset Residual Value	K€	0	0	0	0
Other Revenues	K€	73 756	73 756	55 614	55 614
CASH FLOWS (in k€)					
Cash Flow (SMCP)	K€	26 704	65 892	-16 450	22 737
Cash Flow (Actual)	K€	15 473	15 473	-22 180	-22 180
Risk Evaluation					
risk of lower than expected revenues					
E(D) - std(D)	%	-10%	-10%	-10%	-10%
E(D) + std(D)	%	10%	10%	10%	10%
risk premium of demand based revenues					
Conventional Risk Premium	% of Revenues	2,0	2,0	2,0	2,0
Difference between SMCP and Conventional Pricing Scheme	% of Revenues	2,09	1,86	-	-
	K€	6 487	6 487	-	-
Incentives Analysis					
Actual Capacitiy	ATM/Day	700	700	700	700
PMC Capacitiy	ATM/Day	449	449	310	310
Increase of Revenues with PMC	%	120	118	308	292

Source: ENACT Simulation Tool

The summarized output simulation results of the EST for present values (PV) of SMC pricing (with actual demand) for all scenarios are depicted in Figure 12 and the share of the SMC category in the SMCP structure for the whole concession period for both airports when the base trend scenario (LRMC) is considered are shown in Figure 12 and Figure 13 respectively.

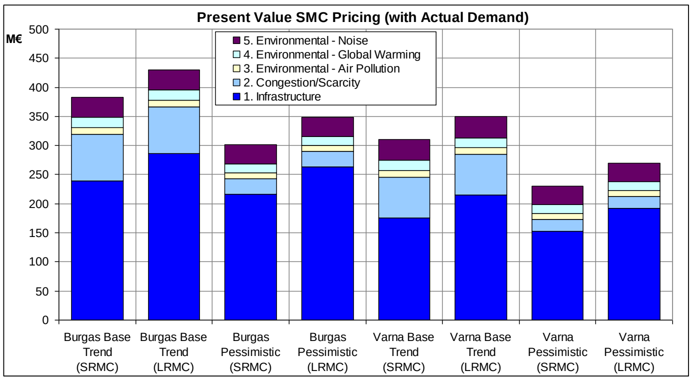

Figure 11:

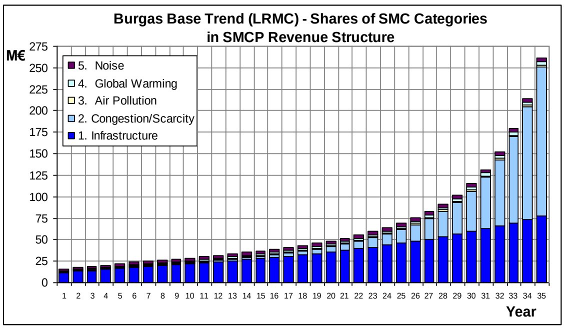

Figure 12:

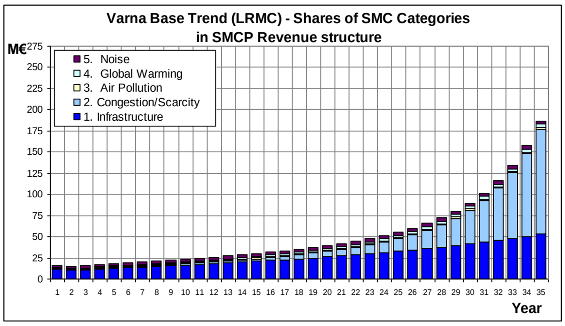

Figure 13:

It was found that all scenarios are feasible under social marginal cost pricing (SMCP), except for Varna (SRMC) and Burgas (SRMC) pessimistic demand scenarios.

The division of Burgas and Varna airports into separate accounting units in order to more distinctively illustrate their operating activities, depending on forecasted demand for each of them, is to a certain extent artificial. Both airports are jointly managed and the government regulation rules are exercised on the basis of their common performance measure (ROI of regulated activities). From this point of view, the joint airport management realizes diversification of risk connected with incomes, respectively of demand. Therefore it is logical that the final results for the airports should be aggregated. The following results illustrate the described approach:

Table 10: **Burgas and Varna considered as one management object**

	Base Demand		Pessimistic Demand	
	Excess/Shortage Revenues MSCP	**NVP(Actual)**	**Excess/Shortage Revenues MSCP**	**NVP(Actual) million €**
Varna & Burgas – SRMC	**43,634 / 16,541**	**90,605**	**-37,170 / -51,407**	**12,620**
Varna & Burgas – LRMC	**129,942 / 101,124**		**49,137 / 31,129**	

The reported figures also show that with LRMC the revenues of the current pricing scheme are lower than MSCP revenues in all cases. In the base demand scenario with LRMC for both airports, LRMC exceeds NVP (actual pricing scheme) at € 39,337 m in the case without risk premium and at € 10,519 m in the case with “full” risk premium for SMCP. For the 35-year concession period, these figures are about 5.1 % and 1.38 % of the NVP of the generated revenues of the concessionary, which is notable.

The analysis of the pessimistic demand scenarios shows that the scenarios with SRMC cannot ensure financial viability for both airports.

On the basis of the operating concession of Varna and Burgas airports, the analysis of the results obtained with EST enables some conclusions concerning the practical application of SMCP to be drawn:

- The long concession period is a reason for the traffic forecast to be rather uncertain, which rather questions the financial viability of the concessionary under SMCP. As can be seen from the pessimistic scenario, the NVP of the predicted activity of both airports is either negative (Varna – NVP (actual) or not large (Burgas NVP (actual));
- It is difficult to implement annual adapting of pricing with SMC;
- Prognoses of the activities of both airports are linked with the scheme of contractual parameters of the concession that have the following characteristics:
  - the total volume of the investments for the concession period is fixed and does not depend on demand;
  - regardless of the results, the government receives remuneration of about 20 % of the revenues;
  - government regulated landing and passenger charges.

Generally, we can consider that the revenues which the government receives from the concession contract are used for social benefit. Theoretically, in the scenarios with a shortage of PV for the concessionary, the government may concede part of the revenues by reducing the concession fee as a percentage of total revenues.

Financial viability: using the Enact Simulation Tool, financial results are obtained about the SMCP and actual pricing scheme for the 35th concession period of the airports Burgas and Varna. For both airports base and pessimistic (LRMC and SRMC respectively) demand scenarios are modelled, with revenue sharing between the private and public party as outlined in the concluded concession contract.
Modelling results show that all LRMC scenarios are financially viable. The final SMCP and actual pricing scheme results are remarkably close. Generally speaking, about 19.2 % from all revenues are paid to the public party, which we can consider as a part of the costs from external effects. Furthermore, in the pessimistic demand (SRMC) scenarios with shortfalls, if that percentage were to be decreased from 19.2 % to 13 - 15 %, these variants would also become financially viable. The strong non-linearity of congestion cost with respect to demand causes considerable difficulties when applying the SMCP scheme within the actual contractual framework.

4.6 Impacts on Risks and Incentives

In the simulations implemented with the EST, assumed data about the daily demand concerning the 30th year (2036) of the concession are used. Even for the base scenario, the actual daily demand (463 ATM/day for Burgas airport and 450 ATM/day for Varna) is significantly less than the runway capacity (700 ATM/day). The incentive analysis purposes in all scenarios were carried out using the following parameters: potential demand according to officially accepted values of daily demand,, constant average unit revenue, a standard deviation of demand of +/- 10.0 % and a 2.0 % risk premium for demand-based revenues. The marginal external congestion cost functions are defined as 300 €/ATM at 350 ATMs and 800 €/ATM at a volume of 700 ATMs. Concerning the figures for air pollution, marginal cost function has values of 40 €/ATM at 350 ATMs and 80 €/ATM at 700 ATMs, respectively. The global warming marginal cost function finally has values of 90 €/ATM at 350 ATMs and 180 €/ATM at 700 ATMs, respectively.
The obtained results for all viable cases (except for Varna Airport pessimistic demand scenario) show a significant sensitivity of expected SMCP revenues with respect to demand changes. The risk of lower than expected revenues has values from 0.8 to 1.0 times higher than in a conventional pricing scheme, from which it may be concluded that the revenues vary more than the demand. This is a consequence of the fact that runway capacity for a long period is significantly higher than the demand, and significant variation of congestion costs can be observed at the end of the period when the increment of “demand/capacity” ratio is considerable.
It must be noted that this study is relevant for a specific year in the long-run aspect (the 30th year of the concession) and this is the main reason that conclusions for the whole concession period cannot be drawn from the obtained results.
Actually in Varna and Burgas airports, the concessionary is a fully private party. According to the terms of the concession contract, the concessionary is guaranteed a 10.8 % rate of return on equity invested in regulated activities (about 80 % of total investments). If we accept approximately the same rate of return for the non-regulated aviation and commercial activities, then we are approaching 11 % in the concrete case.

This contractual value is significantly lower than the value of similar contracts in other industries, such as electricity or water with guaranteed rates of return around 15 % for the private parties. in order to cover the entire demand risk. In case of the contract of the present case study the government is obliged to support a minimal rate of equity in regulated activities at the rate of 10.8 %, with variation of landing and passenger charges. In this way, the government takes on a significant part of the demand risk. There is no danger of demand distortion because of inelastic demand. According to the EST simulation results, when pessimistic scenarios are considered, the total demand for the concession period is significantly lower than in the base scenarios (Burgas – 16 %, Varna – 21 %) and therefore the scenarios with the biggest negative NPV (SMCP) require mark-ups at the rate of 4 – 6 % of SMCP unit revenue price. Such is the situation with actual demand pricing schemes where the shortage of SMCP revenues requires about 2 – 4 % mark-up.

Keeping in mind that during the initial period of the concession the debt/equity ratio is very high, it may be concluded that the larger part of the total investments are financed by debt (interest about 6 – 8 %) and in the mid term and long term the financing is assured by cash flows. In these circumstances the accepted discount rate of 8.1 % seems reasonable.

In the incentives analysis, the EST determines the level of capacity which maximises the profit that is generated, either by increasing congestion revenues (artificially reducing capacity) or by additionally attracting demand. In all Varna and Burgas scenarios the returned PMC is equal to demand, which could be explained with having enough runway capacity to serve this demand for the whole concession period. Actually, during the term of the concession these incentives would not be relevant under the contractual parameters of the present con-cession. There are essential elements in the contract that block determined incentives and stimulate others. Some of the elements that block the incentives for capacity reduction are the following.

- In the contract the minimum investment program is fixed and does not depend on demand dynamics. The whole demand risk and the shortage of revenues are assumed by the concessionary. Even if it is in to its own benefit, the concessionary cannot reduce the investments with the goal of restricting the capacity. The main share of the investments is stipulated in the first 10 years of the concession and the remainder supports level of tangible assets for the normal functioning of the airports.
- In the whole concession period, even in the Base Scenario, the runway capacity is sufficient to serve daily peak and monthly peak demand. Delays in taking off and landing are incidental and only occur during peak hours on peak days, which makes congestion costs growth flat and hence considerably limit the increment of the SMCP unit price. On other side, with the traffic dynamics, normally the requirements for daily planning of evenly distributed regular and charter flights are growing, with which the peak hour to average hourly demand ratio will be reduced. In general, that is the reason not to raise incentives to increase capacity, and as has been noted, incentives to delay development or reduce capacity are not possible.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 General Conclusions

Looking at the principal prerequisites of the application cases, the following comparative conclusions emerge: both cases consider fairly young airports which are both operated under entrepreneurial conditions. Nevertheless, the nature of investment funding and ownership of the sites differ fundamentally. The first difference is the type of project, which is 'greenfield' in the case of Munich and 'brownfield' in the cases of Varna and Burgas. While Munich Airport was constructed by public loans where payments can be deferred to future periods in case of operative losses, the PPP arrangement at Varna and Burgas demands a proper assessment of returns on investment and of payback periods. The situation of the Bulgarian airports becomes even more difficult as Munich Airport faces stable demand growth levels, while Varna and Burgas are dominated by highly fluctuating holiday travel.

Given the complexity of first best SMCP schemes, the general ENACT project results confirm previous research by recommending second-best solutions in case private capital is involved and cost coverage has to be ensured. In order not to create perverse effect due to profit maximization strategies of private parties, it is recommended to de-couple SMCP revenues from the private parties income by passing it to the government and granting performance-, usage- or availability payments to the private side. Ports and airports may be an exception to this rule. Risk evaluation is a particularly important issue and it should cover a wide spectrum, from planning and traffic risks to ownership and political accountability. SMCP will lead to greater uncertainty and therefore may lead to higher risk premium and/or tension for renegotiation and inevitably increase contractual and transaction costs.

It was the purpose of the ENACT case studies, including the two ones on aviation presented here, to test these findings with existing airports. Returning to the research questions formulated in the introduction to this paper, we can summarize the case study findings as follows:

- Cost recovery: interestingly, the two cases starting from very different demand and capacity utilization levels arrive at more or less the same conclusion on the financial viability. MSCP schemes are found just to cover total costs in the long run, in the case of optimistic demand scenarios. The difference between long-run infrastructure costs and short-run infrastructure costs plus congestion is not decisive in this respect. In the case of the Bulgarian airports, cost coverage even includes the 20 % concession fee to be paid to the government. But both case studies hint at the great degree of uncertainty associated with the projection of costs and revenue figures over 30 or even 35 years.
- Risks: Both sites find that cost coverage will not be possible in the case of low demand figures and that revenues are very sensitive to changes in demand. For example, in Munich a 1 % change in demand implies roughly 5 % change in revenues. This is because of the great importance of congestion costs in the total revenue stream. Considering the legal and organizational problems associated with the introduction of time-variant charges, this finding makes SMCP schemes less attractive for practical application than common average cost-based pricing mechanisms.

- Incentives: both cases find no incentives for airport operators to artificially increase congestion by decreasing capacity or by attracting extra demand. This fact is partly due to the extension programs considered, partly due to the moderating role of air traffic control.

The implementation of demand-dependent pricing systems, moreover, face legal restrictions at the European level (NERA 2005) and the complexity of congestion pricing systems will most likely not be acceptable for airports as well as for airlines. Ways to approach these reservations are to simplify congestion pricing regimes, to develop transparent pricing information systems and, most important, to debate about revenue allocation and earmarking regulations. Finally, it should be seriously considered whether to include air traffic control in the vicinity of the airport when setting up a marginal-cost-based pricing system with congestion components.

5.2 Specific Issues by Case Study

In brief, the Munich Airport case study finds that SMCP schemes in airport infrastructure are technically feasible and, if congestion costs are included, could be financially viable for dynamic international hub airports. However, the congestion element causes a very high demand risk, which could be relieved by putting caps on congestion prices or revenues. S schemes with congestion provide positive incentives to airport managers to increase capacity, and thus a transfer of international hub airports to private parties within PPP frameworks is only hindered by fiscal and political interests of the public sector.

The main conclusions that can be drawn from the accomplished case study of Varna and Burgas airports are as follows: All scenarios based on long-run marginal costs (LRMC) ensure cost recovery and 19.2 % share of the revenues transferred to the government as a concession fee. Of the scenarios based on short-run marginal costs (SRMC), in the case of transfer of 19.2 % revenue to the government for both airports, only the scenarios with pessimistic demand (SRMC) do not ensure costs recovery. In fact, without subtracting the concession fee, the recovery cost ratio is greater than 1 for all scenarios.

5.3 Transferability of Findings

The investigations of three airports in two very different regions of the European Union provide only a limited insight into the conditions at European airports in total. Further, the private organization of the airport sector and its dynamic development limit solid conclusions on current cost structures and, even more, on their future development. Thus, a small change in the coefficients derived for the cost and revenues forecasting models can alter the results of the financial and risk analysis completely. This diagnosis has two important implications: first, the results presented here are to be considered with care and second, the application of the chosen methodology to other airports could lead to completely different results.

Nevertheless, it is remarkable that the two case studies arrive at the same cautiously positive diagnosis concerning the financial viability of marginal social cost-pricing schemes. The advanced pricing structures in Switzerland, Sweden and recently in Germany further underline the technical feasibility and the acceptability of variable pricing schemes, in case the self-financing paradigm of commercial aviation is respected. These implementations and the current research results should encourage undertaking further in-depth studies in the direction of internalizing the external costs of this very dynamic transport sector.

All in all, the revenue situation under marginal social cost pricing conditions in aviation is considered stable, compared to the road sector, where external cost elements take a much higher share. With their comparably high degree of variable costs and the largely public ownerships, European airports can generally rely on a rather stable revenue basis making them less vulnerable to short-term fluctuations in charging income. But this diagnosis is only relative to the road sector. Given the cautious financial and risk results reported above, they do not automatically lead to a recommendation to introduce social cost pricing schemes at commercial airports.

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