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Income statement as an assessment tool of an airport operator: A case study of Polish airports

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ABSTRACT

Objective: This article aims to show the characteristics of airport finances and its implications for operational management. It presents comparative case study analysis and tools to evaluate income statement data as a basis for assessment of the financial condition of an airport operator.

Research Design & Methods: The paper is divided into three parts. The first one focuses on the characteristics of airports' typical revenue structure and is operational consequences to the managerial board. It is discussed how to resolve infrastructure bottleneck problems with financial techniques. The second part is devoted to the operational cost analysis with an attempt to check whether popular hypotheses concerning airports' finance specifics apply to Polish regional airports. The analysis examines the elasticity of fixed costs regarding the number of passengers served. The last part of this paper contains a break-even point analysis of Polish regional airport as a benchmarking tool of comparative analysis.

Findings: An analysis of costs at Polish airports was carried out confirming the thesis about a very high share of fixed costs in the total operating costs of aviation activities and its small elasticity regarding number of passengers served. Profitability thresholds at Polish airports were examined, confirming the thesis that profitability is usually achieved after exceeding the 1 mln number of passengers served annually. This number corresponds to annual revenues of about PLN 50 million.

Contribution & Value Added: Investigation of the measures and determinants of airports finance characteristics gives insight into the relationship between infrastructure throughput and break-even point.

Article type: research paper

Keywords: airports; finance; break-even point; operational management; infrastructure bottleneck

JEL codes: G00, G30

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INTRODUCTION

The airport is created to meet the needs of customers, using human and capital resources in such a way to provide income to owners, on one hand, prosperity and development to the region on the other. Each of these elements requires separate analysis and is subject to management. The needs of recipients are examined employing a quantitative and qualitative analysis of demand and its results support making decisions about what services and at what price to offer. The economics of the company provide knowledge about the effective management of airport resources. Research on the impact of an airport on social well-being and creating both positive (e.g. income, jobs) and negative effects (air noise, air pollution) are carried out mainly using quantitative methods (econometric models, macroeconomic models including general equilibrium models)). The assessment of the airport's development phase requires a diagnosis of the actual state of the enterprise. Machaczka (1998) notes that the main reason for the lack of development of the organization is poor management, which results mainly from the lack of sufficient information about the current state of the enterprise and opportunities and threats from the environment.

The functioning of airports in a competitive environment, in which pressure to increase efficiency comes from both airlines and competing airports, as well as changing the strategic position of airports to market-oriented, requires constant investment in development and devoting more and more money to the ongoing operation of the airport. Therefore, it seems that for both owners and managers of airports, the ability to assess the company's operations should become an increasingly important area of interest. It is a starting point in the decision-making process regarding both the current functioning of the airport (operational management) and its future development (strategic management). The purpose of this article is to present and evaluate the usefulness of data from the profit and loss account for the comparative assessment of airports' operations. A break-even point analysis of Polish regional airports is presented as a case study supporting the objectives of the paper.

THEORETICAL BACKGROUND AND EMPIRICAL FINDINGS

Information on the costs and revenues of an airport are the basis for the management of an enterprise, regardless of the formulated function of its business purpose. Cost analysis makes it possible to assess the quality of the process of creating services at an airport. The price level for services has an impact on the market exchange process. The main source of airport financing should be its funds derived from revenues generated by the airport (Tłoczyński, 2011).

The source of the airport's revenues are revenues for air and non-aviation services. According to the Aviation Law Act (Ustawa prawo lotnicze, 2002) and the Regulation of the Minister of Infrastructure and Development on airport charges (Rozporządzenie Ministra Infrastruktury i Rozwoju, 2014), Polish airports may or may not charge airline fees for standard services, i.e.

- take-off or landing fee;
- parking fee;
- passenger charge;
- freight fee;

– noise fee;
– security charges.

The above-mentioned set of charges to some extent reflects the way costs are generated at the airport. Part of the cost (e.g. maintaining the terminal in the long run) depends on the number of passengers served. Other (e.g. maintenance of the runway, taxiways, and parking stands) depends on the number of aircraft served and based.

It is worth noting that the dynamics of airport charges may reflect the degree of use of various airport infrastructure elements. Decreasing MTOW (Maximum Take-off Weight) fee dynamics (regressive rate) may indicate low runway capacity inventory, and terminal capacity high capacity inventory. In turn, the progressive MTOW rate may suggest the opposite situation, i.e. free runway slots while using almost 100% capacity of the terminals. Similar tendencies may show other types of fees, e.g. parking fees depending on the use of apron space. It may be characterized by increasing rates dynamics when there are few free places/slots, and decreasing ones when there are many free places/slots.

An extreme example of an airport with heavily limited runway capacity is London-Heathrow (LHR), which serves over 70 million passengers annually through 5 terminals, and has only 2 runways. For comparison, Amsterdam-Schiphol Airport (AMS) with around 60 million passengers has as many as 6 runways. Based on the data contained in Figure 1, it can be concluded that LHR runways (located in parallel at a distance of 1.4 km from each other) can handle a maximum of 119 air operations per hour. For AMS, this value is at least 2 times higher (not all runways can operate independently of each other). For this reason, the capacity of runways in LHR is so-called "Bottleneck", and as a result, its free runway time slot is much more valuable than that of competitors.

LHR management, guided by maximization of profits, prefers landing of aircraft that can take as many passengers as possible, because the passenger service infrastructure at these five terminals has a relatively high maximum capacity. Following international regulations, management may not prohibit landing with small light aircraft, but it may effectively discourage their owners by using the price list. It was decided to set a fixed landing fee, which is dependent on the maximum take-off weight of the aircraft. In 2014, this fee was EUR 9196, as shown in Figure 2 and Table 1. This design of the price list means that the owners of small aircraft choose other airports, e.g. London-City, so that terminals in LHR can handle a relatively large number of travellers despite a limited number of runways.

The opposite situation could be seen in the price list of Warsaw Chopin Airport (WAW) from 2013. Apart from the fixed fee for aircraft MTOW not exceeding 5t, the rate from the take-off mass for aircraft up to 40t was slightly lower than for ones over 40t. This could indicate a shortage of runway slots and depleted terminal capacity. In the case of the WAW price list from 2020, you can see a correction in the opposite direction. The fee for each ton of MTOW for aircrafts not exceeding 100t is PLN 40, while for every ton above 100 tonnes it is only PLN 10. This may indicate a dynamic response of the board to the exhausting capacity of runways, the number and layout of which has been unchanged for several decades (according to data from Figure 1, their capacity is up to 60 operations per hour), while the capacity of the remaining elements of the airport infrastructure was recently improved several times, including by expanding the terminal area.

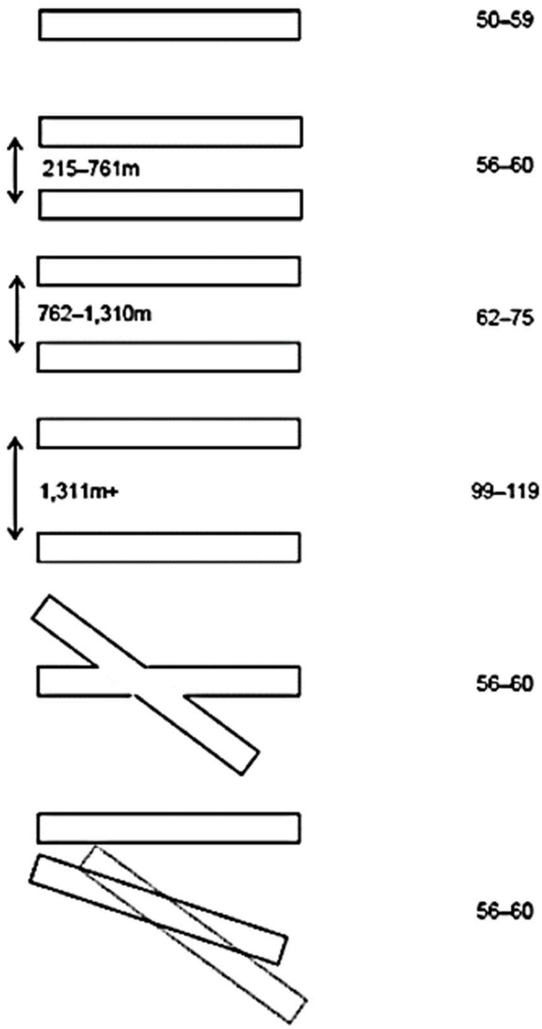

Figure 1. Maximum number of flight operations per hour depending on the runway configuration
Source: (Competition Commission, 2009).

Table 1 presents the calculation of airport charges per passenger and the maximum take-off mass at LHR and WAW airports in 2013. Also, the last two columns include the charge for the maximum take-off mass only. The middle WAW columns EUR and LHR EUR only include landing and passenger charges (PAX) without night and noise fees nor discounts. The table shows, among others, that the Cirrus SR 22 aircraft landing at LHR was up to 100 times more expensive than landing at WAW (9296 vs. 91). For larger aircraft, this difference becomes relatively smaller. For Boeing 737, which is the basis of the fleet of the largest European low-cost Ryanair carrier, the difference is five times. For the Boeing 787 Dreamliner, which become the basis of the LOT fleet, the difference is three times, and for the largest passenger aircraft in the world Airbus A380, the difference is two and a half times.

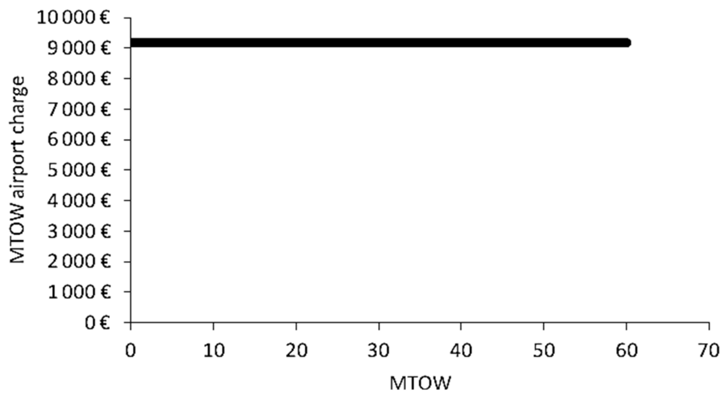

Figure 2. Airport charges calculated on the maximum take-off mass (MTOW) in tonnes at London Heathrow Airport (LHR) in 2014
Source: own elaboration based on the LHR airport charges list (Heathrow, 2014).

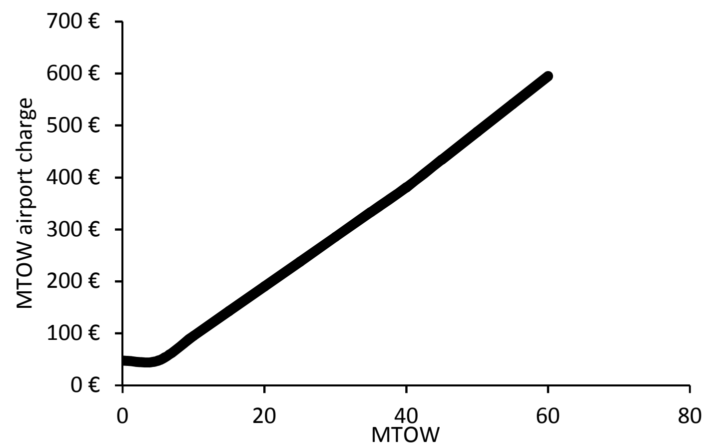

Figure 3. Airport charges calculated on the maximum take-off mass (MTOW) in tonnes at Warsaw Chopin Airport (WAW) in 2013
Source: own elaboration based on WAW airport charges list (Announcement, 2012).

In addition to revenues from aviation activities, revenues from the so-called commercial, non-aviation activities. These are incomes from operations that are not directly related to the operation of aircraft but take place within the terminal or the area managed by the airport. These include (Doganis, 1992; Tłoczyński, 2011):

– rents from the leased terminal space for commercial and service activities,
– revenues from car parks,
– rental of advertising space,
– lease of land, offices, hangars and warehouses,
– other activities located in the port area (hotels, conference centres, vending machines, etc.).

Table 1. Comparison of airport charges at Warsaw Chopin Airport (WAW) and London Heathrow Airport (LHR) in 2013.

Aircraft type	MTOW (t)	PAX	WAW EUR	LHR EUR	MTOW WAW EUR	MTOW LHR EUR
Cirrus SR 22	2	3	90,95	9 296,3	47,62	9 196,4
Piper PA34 Seneca	3	4	105,48	9 329,6	47,62	9 196,4
Cessna Citation	7	8	182,38	9 462,8	66,67	9 196,4
Saab 340	14	33	611,43	10 295,1	133,33	9 196,4
ATR ATR72-500 (LH)	23	68	1 204,52	11 460,4	219,05	9 196,4
Bombardier DH8-400 (LH)	29	70	1 290,48	11 527,0	276,19	9 196,4
Bombardier CRJ-900 (LH)	37	86	1 598,57	12 059,7	352,38	9 196,4
Embraer 190 (LH)	48	100	1 915,95	12 525,8	466,67	9 196,4
Embraer 195 (LH)	53	116	2 201,19	13 058,5	520,24	9 196,4
Boeing 737-500 (LH)	63	120	2 366,43	13 191,7	627,38	9 196,4
Boeing 737-300 (LH)	57	140	2 591,90	13 857,6	563,10	9 196,4
Airbus A320-200 (LH)	78	168	3 222,86	14 789,8	788,10	9 196,4
Airbus A320-200 (WIZZAIR)	78	180	3 396,67	15 189,4	788,10	9 196,4
Boeing 737-8AS (RYANAIR)	85	189	3 602,14	15 489,0	863,10	9 196,4
Airbus A321-200 (LH)	94	200	3 858,10	15 855,2	959,52	9 196,4
Airbus A330-300 (LH)	240	221	4 976,67	16 554,4	2 523,8	9 196,4
Boeing 787 Dreamliner (LOT)	250	252	5 479,52	17 586,5	2 630,9	9 196,4
Airbus A340-600 (LH)	368	306	6 894,29	19 384,4	3 895,2	9 196,4
Boeing 747-400 (LH)	397	344	7 600,24	20 649,6	4 205,9	9 196,4
Boeing 747-8I (LH)	443	356	8 020,71	21 049,1	4 698,8	9 196,4
Airbus A380-800 (LH)	560	526	11 111,2	26 709,1	5 952,3	9 196,4

* charges include landing and passenger charges (PAX) only, without night, noise and discounts.
Source: own elaboration based on WAW and LHR price lists (Announcement, 2012; Heathrow, 2014).

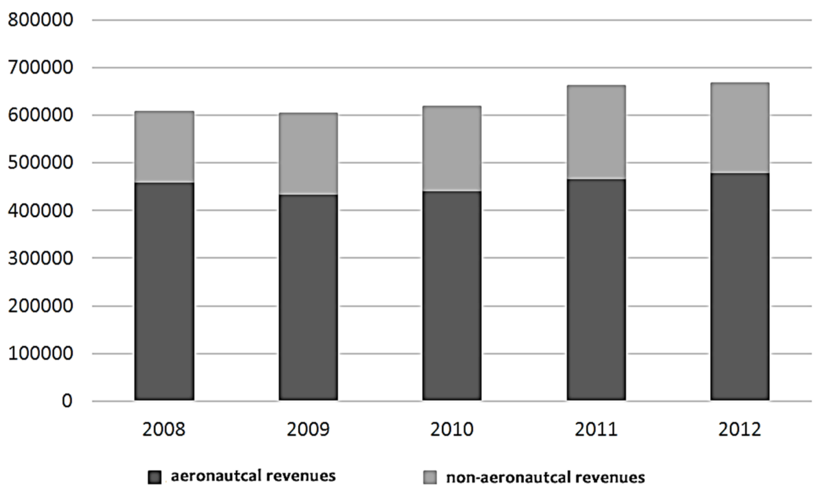

Figure 4. The structure of revenues of the Warsaw Chopin Airport (WAW) in 2008-2012
Source: Own elaboration based on (Przedsiębiorstwo Państwowe Porty Lotnicze [PPL], 2009; PPL, 2010; PPL, 2012).

Doganis (1992) indicates that in Western Europe and the USA, the emphasis on obtaining revenues from the sale of non-aviation services has been visible since the late 1970s, when competition between large airports began to intensify. In Poland, commercial orientation is noticeable after 2004, when Poland joined the EU, and thanks to the "Open Skies" agreement, the so-called low-cost airlines have started to penetrate the market of Polish regional airports. The entry of new carriers on the one hand has enabled many Polish regional ports to significantly increase passenger traffic and reach the break-even point. On the other hand, "low-cost airlines", due to their high flexibility as to destination choices, benefited from their great bargaining power and often through negotiations led to a strong reduction in unit margins on aviation activities at regional airports. As a result, Polish airports are currently under pressure to increasingly use revenue opportunities from non-aviation activities.

The structure of revenues of the Warsaw Airport in the period 2008-2012 is illustrated in Figure 4. Although the volume and value of services sold increases, the share of non-aviation revenues is stable and amounts to 28-29%. In 2009, there was a 0.7% decrease in sales revenues compared to 2008, which was caused by the effects of the global economic crisis (Table 2). The decrease in the number of passengers had an impact on the decrease in the number of passengers (by 12.2% less passengers in 2009 compared to 2008), and a decrease in the number of airport charges being a response to the expectations of air carriers, who due to the economic slowdown were forced to reduce costs. Aircraft take-off and landing fees have been reduced. A 15% rebate on passenger charges was introduced in domestic traffic. The noise fee was diversified by increasing the rate for flights carried out at night and at the same time reducing it for day hours; the aircraft parking fee was abolished and the exempted aircraft parking time was shortened. Revenues from air services decreased by 5.4%, while revenues from non-air services increased by 14.1% (Table 2). Thus, the decrease in the level of aviation revenues at the Warsaw Airport caused by the decrease in aviation traffic was compensated by increased revenues obtained from non-aviation activities. The increase in the value of sales of non-aviation services in 2009 concerned the increase in revenues from the rental of commercial space and the sale of advertising space (an increase of 62%). The sales of parking services also decreased, which was caused by a decrease in the number of passengers in 2009 (PPL, 2009).

According to Doganis (1992, pp. 54-58), commercial revenues are easier to generate for large airports, in particular those that handle large international transfer traffic, because such passengers spend more time inside the terminal waiting for a change. Other factors that seem to facilitate the increase of commercial revenues are the large area of land owned by the airport, proximity to the city, or other intermodal transport infrastructure (Graham, 2009b). An example is the Poznań Airport company, which owns land located near downtown, but at the same time near the expressway. These lands are leased to carry out activities whose recipients are not only persons using airport services. An example of commercial ventures located near Poznań Ławica Airport is a gas station, a chain restaurant, and a car dealership. It is hard to compare commercial incomes of airports as not every company has possibilities to monetize such valuable assets as above mentioned.

Table 2. Detailed structure of revenues of the Warsaw Airport in 2008 and 2009

	2008		2009		Change 2009/2008
	Value	Share	Value	Share	
Aviation services	**460 069**	**75,7%**	**435 285**	**72,1%**	**-5,4%**
take-off/landing fees	142 425	23,5%	124 152	20,6%	-12,8%
passenger fees	248 897	41,0%	243 559	40,4%	-2,1%
aircraft parking	4 813	0,8%	4 930	0,8%	2,4%
noise emissions	21 827	3,6%	15 122	2,5%	-30,7%
providing airport infrastructure	26 236	4,3%	33 539	5,6%	27,8%
access to airport facilities and equipment	13 988	2,3%	12 055	2,0%	-13,8%
others	1 882	0,3%	1 929	0,3%	2,5%
Non-aviation services	**147 287**	**24,3%**	**168 038**	**27,9%**	**14,1%**
space rental	85 535	14,1%	101 514	16,8%	18,7%
car parking	21 913	3,6%	18 442	3,1%	-15,8%
VIP lounges, transit hotel	9 991	1,6%	10 863	1,8%	8,7%
advertising and promotion	7 297	1,2%	11 784	2,0%	61,5%
sharing media	8 318	1,4%	10 307	1,7%	23,9%
others	14 232	2,3%	15 128	2,5%	6,3%
Together	**607 356**	**100,0%**	**603 323**	**100,0%**	**-0,7%**

Source: own study based on (PPL, 2009, p. 63).

The share of non-aviation revenues at Polish airports is very diverse. In 2011 it ranged from 9% in Rzeszów to 75% in Bydgoszcz. The second-highest share of 60% was recorded at Szczecin-Goleniów Airport. At most regional airports, the value of commercial revenues was approximately 1/3 of the total revenues. A relatively low share was achieved by the main Polish hub in Warsaw, which was only 28%. Companies are reluctant to publish the above data, indicating their high sensitivity and lowering negotiating position with carriers, however, it can be learned from industry sources that in subsequent years non-aviation income increased significantly not only in nominal terms, but also as a percentage as a share in total revenues.

Compared to foreign airports, the average value of non-aviation revenues at Polish airports was significantly lower in 2011 and amounted to 28%. For comparison, airports in the British BAA group recorded a share of revenues from commercial operations on average of 33%. In this mature market, these values are not as diverse as airports, because deviations from the average are only a few percentage points. The high development potential of the Polish non-aviation sector may also be indicated by relatively higher average results recorded in other parts of the world. The lowest average results of 34% and 36% are achieved respectively in South America and the African continent. North American companies are leaders in achieving high results in this field, where the average results are 53%, while the values very close to the world average of 46% are achieved in both Europe (44%) and Asia (47%).

To achieve growing revenues from non-aviation sources, airports are increasingly using activities borrowed from large-scale commercial facilities. One of these techniques is commissions charged on sales, which replace completely or partially fixed rents, which until now were the most commonly used method of settling rents. Thanks to such measures, airports can automatically increase revenues from non-aviation sources along with the increase in air traffic without the need to periodically renegotiate fixed rates (Baca, 2011a).

Table 3. Share of non-aviation revenues at selected British and Polish airports in 2008 and 2011

Average share of non-aviation revenues for continents (2008)							
Africa	Asia	Europe	N. America		S. America		World
36%	47%	44%	34%		53%		46%
British airports BAA group (2008)							
LHR	LGW	STN	GLA	EDI	ABZ	SOU	average
33%	42%	38%	33%	31%	22%	38%	33%
Chosen Polish airports (2011)							
WAW	BZG	SZZ	KTW	WRO	POZ	RZE	average
28%	75%	60%	33%	32%	32%	9%	28%

Source: own study based on: (ACI, 2009; Competition Commission, 2009; PPL, 2009; Stefańska, 2012).

Another popular way to increase commercial revenues is to rearrange the space inside the terminal. According to industry sources, the propensity of passengers to make shopping decisions increases significantly after checking-in and passing personal control. For this reason, every square meter of the airside departures area generates up to several times higher unit revenue compared to the public area of the landside part of the terminal. However, most airports in Poland were not built to maximize commercial revenues. An example would be two-story terminal No. 1 in Poznan airport (POZ), which was designed as a cargo sorting facility and later redesigned into public passenger spaces without the use of explicit commercialization measures. For this reason, it can be expected that shortly management boards will try to expand the area of departure halls or completely rearrange the interior of buildings. The simplification of procedures (e.g. self-check-in) could also be an ad hoc action to reduce the time spent by the passenger in the public area and the check-in process.

Currently designed departure areas make airside interiors more and more look alike the interiors of shopping centres. Techniques borrowed from this sector include mobile shopping outlets, better product display, and arrangement, which means that passengers, striving for their exit gate or walking around the terminal, pass as many products and services purchased on impulse as possible. An extreme example of such space are walk-through stores, which occupy the entire width of the aisle and force travellers to squeeze with hand luggage between store shelves (Baca, 2011b).

There are consulting companies that specialize in arranging departure halls and optimizing commercial revenues. An example of the arrangement of the commercial zone of the passenger terminal is the diagram shown in Figure 5. In addition to the duty-free store type “walk-through” located just behind the personal control, the entire departure hall is a commercial space, where individual boutiques alternately represent various types of activities such as services, shops and gastronomy.

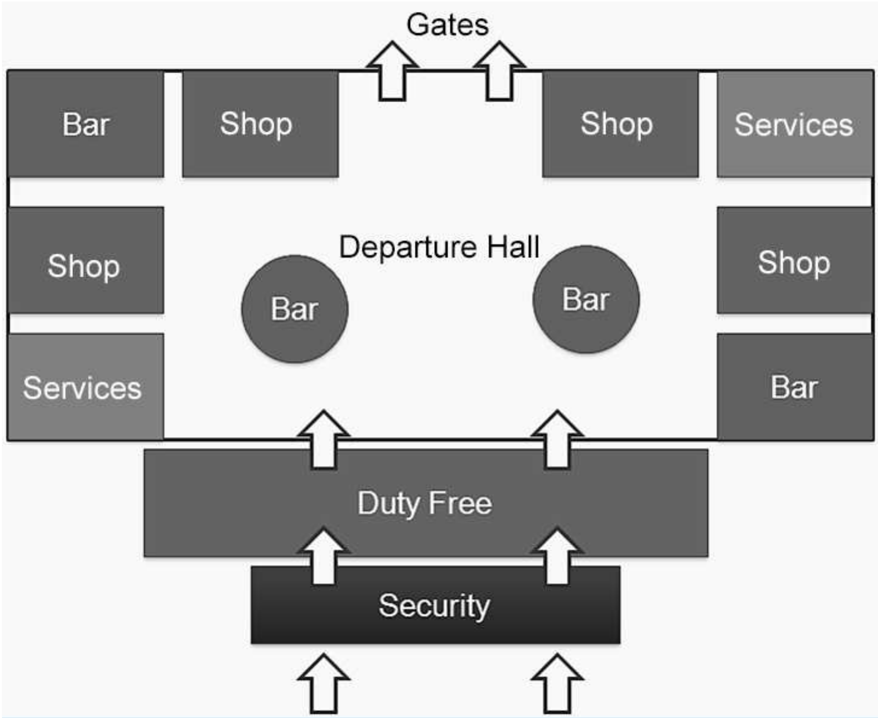

Figure 5. Arranging the departure area to maximize commercial revenues
Source: Own elaboration based on (Gray, 2010).

Additional food outlets should be located in the middle of the hall, thanks to which every diagonal walk is associated with exposure to impulsive shopping-related stimuli. Seats and boards informing passengers about departure gate numbers and departure times should also be located in this zone, so travellers spend more time in the commercial area and are subjected to shopping stimuli for longer (Gray, 2010).

Not only the size and arrangement affect commercial revenues. One of the factors is also the type of connection network and the prevailing type of carriers. For example, at London Heathrow airport, which is dominated by traditional carriers providing largely intercontinental long-haul services, the largest share (35%) have revenues from duty-free stores, as illustrated in Figure 6. This is possible because a large part of the destinations served are provided to countries that do not belong to the customs union, and therefore duty-free stores can be relatively competitive in price. For London Stansted airport, which mainly offers low-cost flights to other EU countries, prices in duty-free stores are less competitive. The relatively large share of revenues from stores with food products and beverages also seems significant at this airport. This phenomenon can be explained by, among others lack of free meals on board of aircraft based there which are mainly low-cost carriers. (Graham, 2009a).

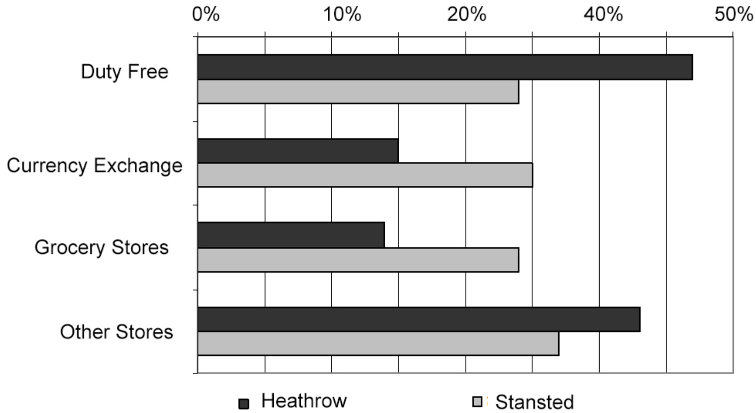

Figure 6. Retail structure in the port of London Heathrow and London Stansted
Source: (Graham, 2009a).

OPERATING COSTS OF AIRPORTS

Ruciński (1998, p. 87) noted that in the case of maintaining constant 24-hour airport operation time, almost all costs by type and in the calculation system are permanent. When the volume of air traffic changes, even by 30-40%, the total costs will stay in the range of 3-5%.

It should be remembered that the above thesis concerns a rather short time horizon, which does not take into account the investment cycle of the airport.

At the time of construction or purchase of additional airport infrastructure and equipment, costs increase by leaps and bounds. In turn, the dynamics of passenger traffic dynamics are characterized by greater stability of the growth rate. In the period in which large investment outlays were made, the opposite may occur, namely, costs may increase by 30-40%, while passenger dynamics may increase 3-5%.

To analyse these two situations, a long-term analysis was carried out for 11 Polish regional airports (LCJ, WMI, KRK, KTW, LUZ, RZE, POZ, SZZ, WRO, BZG, GDN) in the period 2000-2015 (125 observations) using linear regression for the dependent TC variable (total costs) and the independent PAX variable (number of passengers served). Statistical significance (***) $p < 0.0001$ was confirmed for the relationship: TC=0,028PAX+19542 (thousands PLN).

This means that, on average, each passenger at Polish airports increased variable costs by PLN 28. To compare these values to Ruciński's thesis (1998), the percentage changes in total costs were compared with the percentage changes in the volume of passenger traffic. The elasticities calculated in this way took very different values (from -96 to 1245). If only the arithmetic average of 9.9858 is taken into account, it can be generally confirmed that there are airports where 40% growth of passenger traffic (PAX) caused a 4% increase in total costs (TC). In other words, for every 1% increase in total costs, there is a 10% increase in passenger traffic. The median in this set contributed only 0.377, therefore the distribution is characterized by right-hand asymmetry, i.e. in most periods airports recorded slightly lower elasticity than the arithmetic average indicated above.

Fixed costs in the short term consist primarily of depreciation, but also costs associated with the ongoing maintenance of the facility in the form of material and energy consumption. On the example of the financial data contained in Table 4 and Figure 7, it can be seen that the depreciation in GDN and POZ alone account for 20% to 30% of all costs. It is worth noting that as the airport develops, the share of depreciation in the total costs increases. With an increase in passenger traffic from 1.2 to 3.7 million, depreciation at the Gdańsk Airport increased from PLN 6 million to PLN 40 million (Table 4). The share of material and energy consumption in the structure of operating costs is similar in all analysed companies, amounting to around 10% regardless of the reporting period.

Labour costs represent a relatively lower share than in other transport-related industries, although a large variety of outsourcing makes it difficult to compare. Some airports outsource only the simplest tasks, such as security, cleaning, etc., while others decide to outsource to a much wider extent. Often, even half of all people working in an airport are people dealing with handling. If this activity is outsourced, the remuneration of these persons will become part of the amount contained in the ‘external services’ line. It is worth remembering when comparing different airports with partial indicators or other benchmarking methods. One way to deal with this problem is to introduce variables in which we add labour costs and external services.

It is a good practice to use EBITDA instead of EBIT when comparing operating profits of airports from different countries. Reducing EBIT by depreciation and interest allows comparative analyses regardless of the differences arising from various depreciation accounting systems and differences in the ways infrastructure is financed.

In the case of the Gdańsk Airport, salaries and social benefits constituted a maximum of 30% of all costs and in nominal terms grew more slowly than other costs. In 2017 their share fell to 20%. A similar tendency was observed in external services, which fell from 17% to 7% in 2017. In other companies, total labour costs usually constitute about 30-35% of operating costs. The highest share, i.e. 40% in 2017, was recorded in the Krakow airport.

The differences in the item “III, External services” are even greater. The smallest share, only 7%, is in a Gdansk company, and the most 26% in Modlin airport. Handling is carried out by external entities at all airports. Therefore, if we assume that the same part of the costs of external services in both ports are labour costs, it can be concluded that the costs related to employees are much higher in Modlin than in Gdańsk.

Table 4. Operating costs of the Gdańsk Airport in the years 2006-2017

Year 20xx	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Number of passengers (PAX) (mln)	1,2	1,7	2,0	1,9	2,2	2,5	2,9	2,8	3,3	3,7	6	4,6
Operating expenses (PLN mln) (100%)	31,8	37,1	44,4	51,1	57,4	61,8	83,9	93,5	97,5	111	116,6	132
Depreciation	**21%**	**20%**	**20%**	**18%**	**12%**	**12%**	**27%**	**32%**	**32%**	**30%**	**33%**	**31%**
Usage of materials and energy	**10%**	**10%**	**10%**	**11%**	**11%**	**10%**	**13%**	**12%**	**9%**	**9%**	**9%**	**8%**
Foreign Service	**17%**	**14%**	**16%**	**18%**	**20%**	**20%**	**9%**	**7%**	**6%**	**7%**	**7%**	**7%**
Taxes and fees	3%	3%	2%	2%	2%	2%	1%	2%	2%	2%	2%	2%
Salaries	**22%**	**21%**	**20%**	**19%**	**18%**	**20%**	**18%**	**18%**	**18%**	**16%**	**15%**	**16%**
Social security and other benefits	**7%**	**6%**	5%	5%	5%	5%	5%	5%	5%	4%	4%	4%
Other costs	**21%**	**25%**	**26%**	**28%**	**32%**	**31%**	**25%**	**25%**	**29%**	**31%**	**29%**	**32%**

Source: own study based on the financial statements of the Gdańsk Airport.

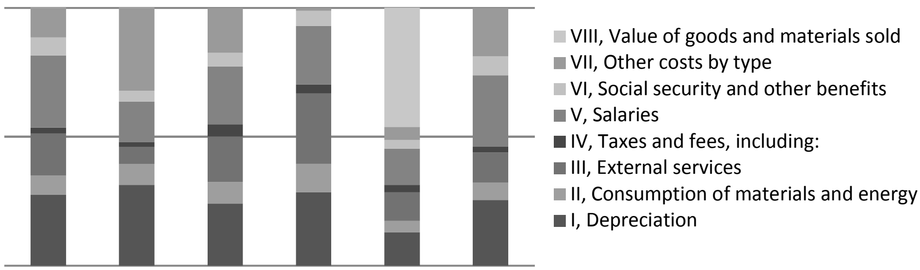

Figure 7. The structure of operating costs at airports: Krakow KRK, Gdansk GDN, Katowice KTW, Warsaw-Modlin WMI, Wrocław WRO and Poznan POZ * in 2017

* The data did not include the item "VIII, Value of goods and materials sold" because the WRO operator is the only one in the analysed group to sell fuel and this item accounted for almost half of operating costs, while in other companies this value is close to zero.

Source: own elaboration based on financial statements.

BREAK-EVENT POINT ANALYSIS

In the literature on the subject, one can come across the repetitive thesis that the quantitative break-even point for airports is usually around 1 million passengers per year. This means that the airport will make a profit when it serves more than the above mentioned one million passengers during a year. In the case of very small local airports, it is recognized that the company can achieve a profitability of just 0.5 million passengers. One such analysis is the work of Adler *et al*. (2013), who examined 85 European regional airports with traffic less than 1.5 million PAX in the period 2002-2009. The results of the research indicate that the profitability threshold for small airports is PAX 0.464 million. Also, it was noted that due to increasing cost burdens (e.g. due to stricter safety regulations), the threshold increased by 100% over the decade.

Another analysis of this type is Bubalo (2012), in which the author compares 210 European airports of different sizes in the period (2002-2010). Regression analyses have shown that airports typically reach a break-even point at EBIT when they exceed about PAX 1 million. The analysis of empirical data also showed that profits significantly higher than zero are obtained only in the case of enterprises with passenger traffic greater than 2 million PAX. The author also indicates that the use of average measures can be harmful to extremely small and extremely large entities discussed in these analyses. In this case, he proposes to use the Profitability Envelope algorithm, which sets a benchmark for each airport from a group of other entities of similar size.

Break-even analysis is a useful tool to study the relationship between fixed costs, variable costs and returns. A break-even point defines when an investment will generate a positive return and can be determined graphically or with simple mathematics. Break-even analysis computes the volume of production at a given price necessary to cover all costs. Break-even price analysis computes the price necessary at a given level of production to cover all costs.

Break-even point can be verified by a mathematical calculation as follows:

Revenues are calculated from equation:

$$R = p\ x\ q \tag{1}$$

where:

R - revenues;
p - price;
q - quantity of production.

Costs can be expressed by the equation:

$$C = FC + vc\ x\ q \tag{2}$$

where:

C - costs;
FC - fixed costs;
vc - variable costs per a piece;
q - quantity of production.

Profit is given well-known equation:

$$P = R - C \tag{3}$$

where:

P - profit;
R - revenues;
C - cost.

To make the profit = 0, it is necessary to apply the equation $(R = C)$:

$$p\ x\ q = FC + vc\ x\ q \tag{4}$$

A critical amount of production, which characterizes Breakeven point, is calculated by gradual modifications of equations:

$$q = \frac{FC}{p - vc} \tag{5}$$

The equation $(p - vc)$ is called allowance for payment of fixed costs and profit, thus covering allowance. The higher the value of the covering allowance, the smaller the quantity of production to achieve a profit. (Kampf *et al*., 2016).

To examine the break-even point of Polish airports, financial data and traffic statistics were collected from 11 regional airports in Poland in 2000-2017 (155 observations). Figure 8 shows net profit or loss in selected enterprises in 2012-2017. Based on the results of the analysis, it can be concluded that large airports with more than 2 million passengers a year, i.e. Kraków Airport (KRK), Katowice Airport (KTW) and Gdańsk Airport (GDN) have relatively high net profits i.e. in the range of PLN 10-50 million The financial result of medium-sized ports, i.e. with a volume of passenger traffic of 1-2 million, oscillates around the break-even point, and smaller ports usually have a loss of up to -50 million (e.g. Warsaw-Modlin WMI in 2013).

To calculate the quantitative and valuable break-even points, two regression analyses were carried out according to the pattern recommended by Aczel (2011). The variable "Net profit" was explained in the first analysis by "the number of passengers served annually" (Figure 9) and in the second by "sales revenues" (Figure 10). In both cases, results with high statistical significance, i.e. with a parameter value of p <0.0001 *** were obtained.

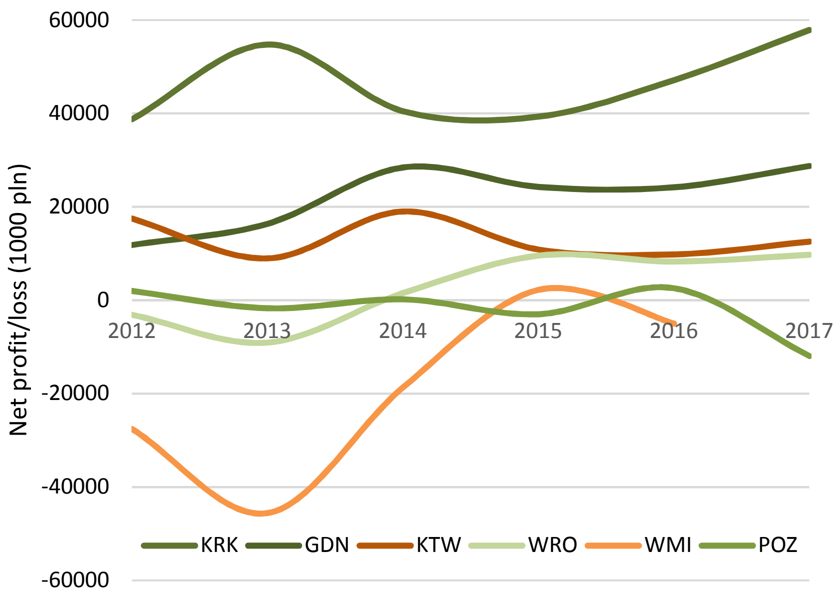

Figure 8. Net profit or net loss of selected Polish airports in 2012-2017 (data in 1000 PLN)
Source: Augustyniak (2017).

For the first dependence the function was obtained:

$$\mathrm{Profit}_{\mathrm{net}} = 0.0117 \times PAX - 13154 \quad (6)$$

The quantitative break-even point understood as the zero value of the above function was obtained for the annual number of passengers served equal to $\mathrm{PAX}_{\mathrm{BEP}} = 1124273$. This value is surprisingly close to the aforementioned number of millions of passengers, which in scientific and industry literature is often mentioned as the 'typical' break-even point at airports.

The second relationship has been described by the function:

$$\mathrm{Profit}_{\mathrm{net}} = 0.249 \times REV - 13073 \quad (7)$$

The value break-even point understood as the zero place of the above function is obtained for the sales value $\mathrm{REV}_{\mathrm{BEP}} = 52502008$ (PLN). This means that a "typical" Polish regional airport achieved positive profit after exceeding PLN 52.5 million in revenues.

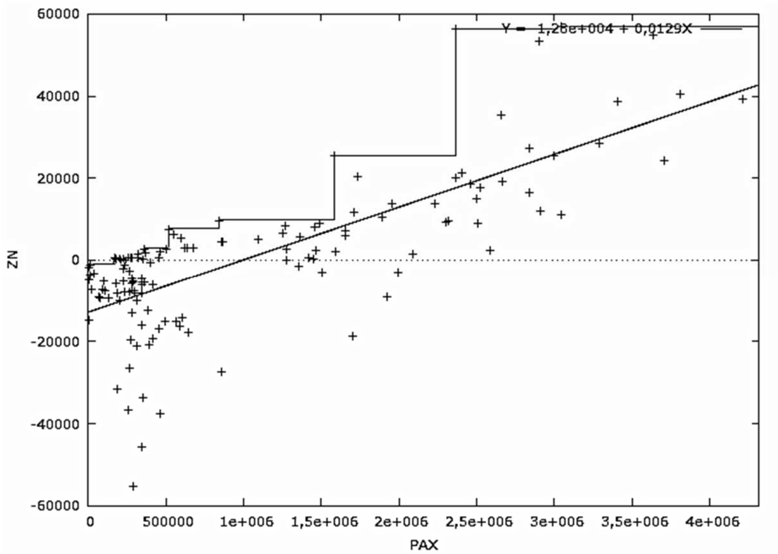

Figure 9. Relationship between net profit ZN (in 1000 PLN) and the number of passengers PAX
Source: own elaboration.

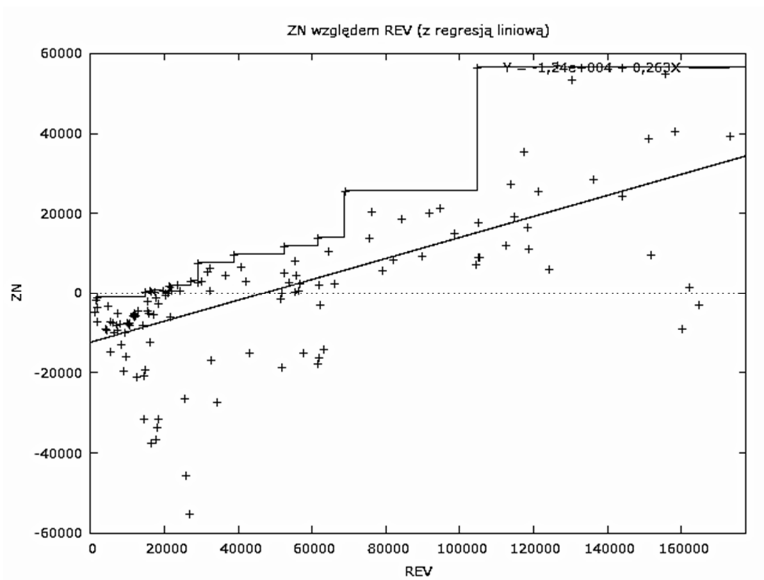

Figure 10. Relationship between net profit ZN (in 1000 PLN) and the value of annual sales revenues REV (in 1000 PLN)
Source: own elaboration.

CONCLUSIONS

This article presents several tools that allow you to familiarize yourself with typical financial characteristics and processes of airports. The structure of revenues at airports was traced, indicating the price list of charges as an example of a tool partially solving the problem of "bottlenecks" when it is impossible to quickly increase the capacity of a critical element of infrastructure. An analysis of costs at Polish airports was carried out confirming the thesis about a very high share of fixed costs in the total operating costs of aviation activities and its small elasticity regarding number of passengers served. A relatively small share of employee costs was also indicated, especially for larger airports.

Despite its theoretical nature, the linear profit function can be used to identify subgroups that contain similar observations in terms of the level of relationships studied (profit, revenues, number of passengers). For this purpose, you can use the Profitability Envelope algorithm (Bubalo, 2012), which allows you to show areas with a step increase in the explained variable. The method consists in dividing the population (in this case airports) into subgroups. In each of them, the observation with the highest profit becomes a relative benchmark for others. In subsequent iterations, by increasing the value of the explanatory variable, the script draws a new group after encountering an observation with a function value higher than the previous benchmark. The graphic results of the script are marked with a broken light shade in figures 9 and 10.

The Profitability Envelope method allowed to set up contractual 3 groups of airports established according to PAX sizes:

- small: with annual passenger traffic below 0.6 million PAX,
- average: with annual passenger traffic of 0.6-1.6 million PAX,
- large: with annual passenger traffic above 1.6 million PAX.

Benchmarks for small airports turned out to be airports in Poznań and Katowice, which at the beginning of the 21st century recorded a positive net profit of about PLN 0.5 million. For medium-sized entities, the Wrocław airport became the benchmark with data from 2010, when net profits of PLN 7 million were achieved. In turn, for large airports, the benchmark was set by the Krakow airport in the period 2006-2008 with net profits exceeding PLN 50 million.

It should be remembered that the results obtained indicate theoretical average levels of break-even points. The inaccuracy of the above modelling corresponds to a fixed residual component in the linear regression model, which forces the assumption that fixed costs do not change in subsequent years of the period under review. In fact, over the longer term, fixed costs increase by leaps and bounds according to the airport's investment cycle. It seems necessary to repeat the research on a larger and more diversified sample. It will allow making a com-parable analysis and take into consideration the impact of national differences on entrepreneurial behaviours. Another important aspect is to analyse institutional forms of support for airports' development and its impact on airports' operators financial results.

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