

# **Analysis of Productivity Level at Airport Companies in Indonesia Using Malmquist Productivity Index (MPI)**

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## **Abstract**

Air transportation in Indonesia is developing very rapidly which is the main factor causing the increase in operational activities at airports in Indonesia from year to year. Indonesia has 17,499 islands with a total area of about 7,810,000 km<sup>2</sup> consisting of an ocean area of 3.25 million km<sup>2</sup>, an Exclusive Economic Zone area of about 2.55 million km<sup>2</sup>, and land with an area of about 2.01 million km<sup>2</sup>. This study aims to analyze the productivity level of airport companies in Indonesia managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) for the period 2011-2020. This study uses the Malmquist Productivity Index (MPI) method to calculate the level of productivity of each company. There are two variables used in this study, namely the input variable and the output variable. The input variables consist of number of runways, terminal size area, number of employments, and total expense. Meanwhile total number of aircraft movements, total number of passengers, total freight, and total revenue as variable output. This research show that PT Angkasa Pura I (Persero) is unproductive, while PT Angkasa Pura II (Persero) is productive. According to previous statement, it can be summarised that PT Angkasa Pura II (Persero) more productive than PT Angkasa Pura I (Persero) to manage inputs and outputs owned by company.

## **Keywords**

Malmquist Productivity Index, Productivity, Airport.

## **1. Introduction**

Transportation is a business of transporting and carrying passengers and goods from one place to another place. These field is important in Indonesia considering Indonesia is one of the largest archipelagic countries in the world. There are three types of transportation classified from the angle of the road or the road surface as well as the means of transportation used, namely land, sea and air transportation (Kamaludin, 2003). Air transportation the latest and fastest means of transportation because this transportation uses airplanes as a means of transportation and air or space as its path, so it is very suitable for mountainous areas, ravines, and so on. Judging from the vast territory of Indonesia which consists of thousands of islands, air transportation operations are an attractive option, especially as a means of connecting people and goods from one region to another.

Air transportation in Indonesia has experienced very rapid development, the trigger for which is the concept of Low Cost Carrier which has changed the rules of the game in the aviation industry (Setyarini & Ahyudanari, 2017). This makes air travel more affordable for people on a moderate budget. Furthermore, air transport is the only means of accessing remote and less developed areas to benefit from connections with the outside world.

Judging from the aircraft movements and passenger movements of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) for the 2011-2020 period tend to increase, although there are several years where it has decreased, especially in 2020 which experienced a very significant decrease when compared to the previous year. In contrast, cargo throughout 2020 PT Angkasa Pura I (Persero) experienced a slight growth, namely by 2.09% from 427,135

tons in 2019 to 436,039 tons, while PT Angkasa Pura II (Persero) was able to record volumes of up to 712.9 million kilograms. This shows that the cargo transportation business is relatively stable when compared to the aircraft passenger transportation market (PT Angkasa Pura II, 2020). Considering that in 2020 for aircraft movements and passenger movements experienced significant decline.

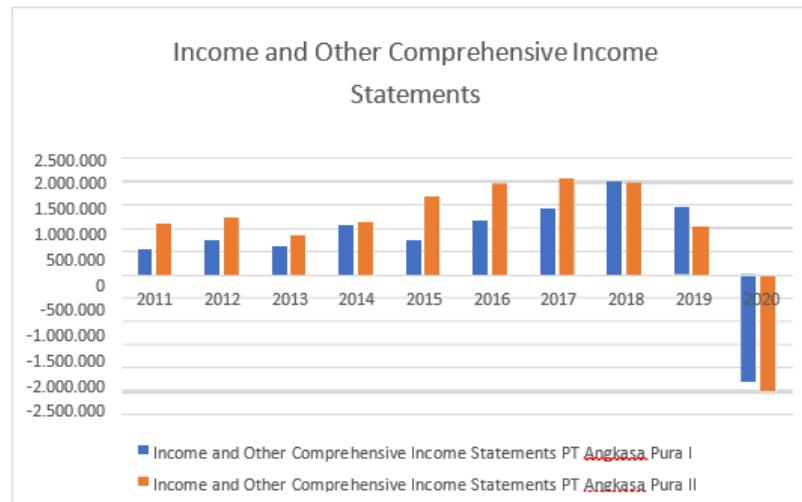


Figure 1. Income and Other Comprehensive Income Statement of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero)

Source: Annual Report of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero), 2021

Comprehensive Income for the Year PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) in 2011 to 2020 tends to increase, although in some years it has decreased (Figure 1). Based on the phenomena and the existing financial reports indicate that there is a possibility of changes in the level of productivity in the company from year to year. To determine the level of productivity at the airport, it can be done using the Malmquist Productivity Index (MPI) approach to determine the level of productivity which can be seen in the results of processing the input and output data that have been determined. The Malmquist Index is part of the DEA (Data Envelopment Analysis) method which specifically looks at the productivity level of each business unit so that changes in the level of efficiency and technology used will be seen based on predetermined inputs and outputs.

Based on this description, the researchers measured the level of productivity at airports managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) in 2011 to 2020. The authors chose the research period from 2011 to 2020 because during this vulnerable period there tended to be an increase in operational and financial conditions. at airports manage by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero). Researchers also chose airport research objects which are only managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) because these airports are active and have a density of aircraft movements, aircraft passengers, baggage and post compared to other airports.

In this study, there are several variables that are used as a reference to see the productivity of an airport company, namely the input variable seen from the number of runways, terminal size area, number of employment, and total expenses while the output variable used is the total number of aircraft movements, total number of passengers, total freight, and total revenue. After seeing the phenomena that have been described and collecting the necessary data, this research is entitled "ANALYSIS OF PRODUCTIVITY LEVEL AT AIRPORT COMPANIES IN INDONESIA USING MALMQUIST PRODUCTIVITY INDEX (MPI)".

Based on the description of the background above, the author has several questions that will be investigated as follows:

1. How is the productivity level at the airport managed by PT Angkasa Pura I (Persero) using the Malmquist Productivity Index?
2. How is the productivity level at the airport managed by PT Angkasa Pura II (Persero) using the Malmquist Productivity Index?
3. How do the productivity levels compare at airports managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero)?

## 1.1 Objectives

The objectives of this research are as follows:

1. To find out the level of productivity at airports managed by PT Angkasa Pura I (Persero) using the Malmquist Productivity Index.
2. To determine the level of productivity at airports managed by PT Angkasa Pura II (Persero) using the Malmquist Productivity Index.
3. To find out the difference of productivity levels at airports managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero).

## 2. Literature Review

### 2.1 Productivity

The theoretical definition of productivity coincides with the common sense notion of the ratio of observed output to observed input in which a producer uses a single input to produce a single output, which this definition will be more complicated when multiple outputs in the numerator must be aggregated by using weights that reflect their relative importance and multiple inputs in the denominator must be aggregated in a similar fashion, so the productivity is from the ratio of two scalars, aggregate output and input, with the time path of aggregate output is an output quantity index, and the time path of aggregate input is an input quantity index (Aparicio et al., 2020).

There are various methods used to measure the productivity of a company, one of which is to use the Malmquist Productivity Index (MPI) which is part of the Data Envelopment Analysis (DEA) model that functions to see the productivity of a company, so that changes in the productivity level of a company will be seen from time to time. To time based on predefined inputs and outputs. The Malmquist Index was first introduced by Malmquist in 1951 where this index serves to compare the input and output that has been set in production.

According to Asker & Yasar (2018), explaining that The Malmquist total factor productivity index measures the change in efficiency by means of two separate components, the change in technology and the change in technical efficiency. The multiplication of these two components yields a total factor productivity index. The direction of change in the amount of output to be obtained by using the input variable with the same characteristics as the change in technology is investigated. Technical efficiency consists of the efficiency of the scale and pure technical efficiency, and it is obtained by multiplication of these indices. In its calculation, this index consists of several results, namely: Technical Efficiency Change, Technological Efficiency Change, Pure Efficiency Change, Scale Efficiency Change, and Total Factor Productivity Change (TFPCH)

In the first-generation model developed by Douglas et al., (1982), there are 2 (two) Malmquist productivity index models, namely 'Malmquist input quantity index' and 'Malmquist output quantity index'. Malmquist input quantity index for a unit of production, at the time of observation  $t$  and  $t+1$ , for reference technology in period  $k$ ,  $k = t$  and  $t+1$ . The Malmquist input quantity index only measures the observed change in the input quantity between time  $t$  and  $t+1$ , where:

$$MI_k(y_k, x_t, x_{t+1}) = E(y_k, x_t) / E(y_k, x_{t+1}), k=t, t+1 \quad (2.1)$$

Meanwhile, the Malmquist output quantity index used for a unit of production, at the time of observation  $t$  and  $t+1$ , for the reference technology in the period  $k$ ,  $k = t$  and  $t+1$  is expressed by the following formula (2.2). This Malmquist output quantity index measures only the observed change in the quantity of output between time  $t$  and  $t+1$ , where:

$$MO_k(y_t, y_{t+1}, x_k) = E_k(y_{t+1}, x_k) / E_k(y_t, x_k), k=t, t+1 \quad (2.2)$$

The new definition of the Malmquist productivity index for units of production between  $t$  and  $t+1$  based on the level of technology at times  $k$ ,  $k = t$  and  $k = t+1$ , follows the tradition of most productivity indices. In keeping with Tornqvist's productivity index, the index is constructed using the ratio between the output index and the input index:

$$MTFP_k = \frac{MO_k(y_t, y_{t+1}, x_k)}{MI_k(y_k, x_t, x_{t+1})} = \frac{E_k(y_{t+1}, x_k) / E_k(y_t, x_k)}{E_k(y_k, x_t) / E_k(y_k, x_{t+1})}, k=t, t+1 \quad (2.3)$$

The equation above describes the ratio between output index and input index of Malmquist. If the value of productivity index (TFPCH) is more than 1, it means that there is an increase in productivity. Meanwhile, if the value of productivity index (TFPCH) is less than 1 it means the productivity level is decreased (Octrina et al., 2019).

### 2.3 Research Framework

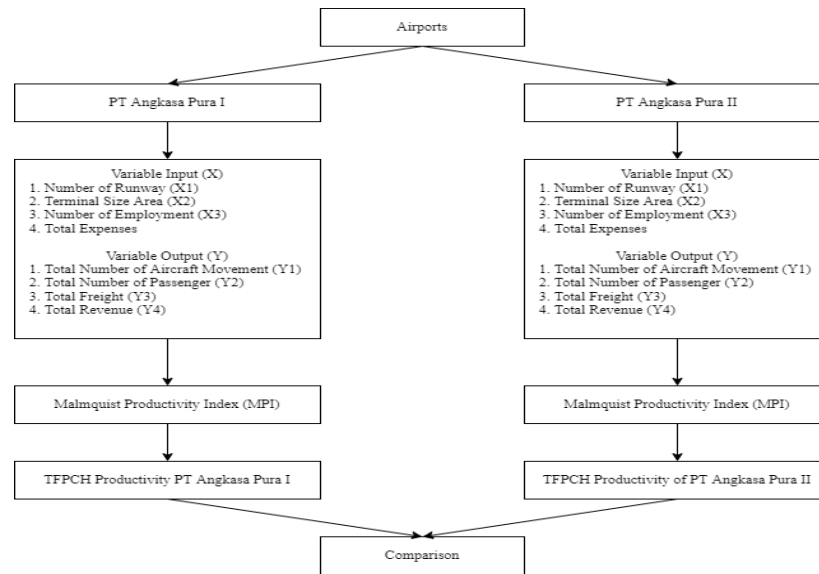


Figure 2. Framework of Productivity of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero)

Source: Processed (2021)

### 3. Methods

#### 3.1 Research Characteristic (Table 1)

Table 1. Research Characteristic

No.	Research Characteristic	Type
1.	Research methods	Quantitative
2.	Research purposes	Descriptive & Verification
3.	Approach to theory development	Positivism
4.	Research strategy	Case Study
5.	Unit of analysis	Organization
6.	Research background	Non-contrived
7.	Execution time	Time-series

Source: Processed (2021)

#### 3.2 Research Stage

##### 1. Observation and Data Collection

At this stage the researcher observes the phenomenon that is happening. The phenomenon that occurs in this study is the very rapid development of air transportation in Indonesia which is one of the factors supporting the increase in operational activities at airports, whether the implementation of operational activities can affect the productivity of airport companies managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero). Then the researcher will collect the data used in this study.

##### 2. Defining the Problem Statement

To find solutions to these problems, the researchers developed a statement/problem formulation that included general objectives and research questions. Collecting initial information about the factors that may be related to the problems in this study then this problem area has 3 research questions.

##### 3. Conduct a Literature Study

This literature study was conducted to find references through relevant journals, books, and articles related to this research regarding airport productivity, research variables, and previous studies that discussed

similar issues.

4. Create Framework

The framework is carried out as the main basis of this entire research to describe the relationship between Input Variables: Number of Runaway, Terminal Size Area, Number of Employment, and Total Expenses and Output Variables: Total Number of Aircraft Movement, Total Number of Passengers, Total Freight, and Total Revenue on the productivity level of airports in Indonesia.

5. Developing Hypotheses

This stage is carried out to determine the level of company productivity at PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) and to compare whether there is a difference in the level of company productivity between PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero).

6. Collecting Data

The data collection technique carried out by the researcher is by using secondary data retrieval from the research object company. The data contains information regarding input and output variable data that have been determined by researchers from 2011-2020.

7. Analyze Data

This stage is done by processing the data that has been done using descriptive statistical analysis. In descriptive analysis, researchers explain the results of data processing input variables (Number of Runaway, Terminal Size Area, Number of Employment, and Total Expenses) and output (Total Number of Aircraft Movement, Total Number of Passenger, Total Freight, and Total Revenue) by using excel to find out the mean, standard deviation, maximum, and minimum values, and after that the researcher explained the meaning of the results of the four values. Then, the productivity input and output variables were reprocessed using DEAP 2.1 software to determine the company's productivity level during the 2011-2020 period. And to find out whether it is productive or not, it is seen from the value of the Total Productivity Factor (TFPCH) > 1.

8. Interpreting Data

After analyzing the data, the researcher explains and concludes the results obtained from processing the data so that it can be seen how the influence of input variables and output variables on the productivity of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero).

### **3.3 Population**

The population used in this study are airport companies in Indonesia manage by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero). In this study, the authors conducted a case study in which there were two objects in the research, namely PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero). So that the sampling technique used in this study is total sampling, which is a technique in which all members of the population are used as samples (Sugiyono, 2019).

### **3.4 Data Analysis Technique**

1) Productivity Research Through Malmquist Productivity Index (MPI)

This study uses Data Envelopment Analysis (DEA) analysis techniques with the Malmquist Productivity Index (MPI) approach which is a non-parametric analysis method to measure changes in total productivity of each production unit compared to other production units that have the same goal. This production unit is called a decision-making unit (DMU) which in the research is an airport in Indonesia which is managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero). To calculate the value of productivity through MPI can be calculated using DEAP 2.1 software. The measurement using the Malmquist Productivity Index method consists of several results, namely: Technical Efficiency Change, Technological Efficiency Change, Pure Efficiency Change, Scale Efficiency Change, and Total Factor Productivity Change (TFPCH) (Asker & Yasar, 2018).

2) Data Normality Test

The data normality test was carried out to see the distribution of the variables to be studied (Ghozali, 2018). The data normality test is also used as a condition before conducting a differential test. In this study, the data were tested using Shapiro-Wilk. The Shapiro-Wilk (S-W) test was used because the data used in this study was less than 50. For the data normality test will use SPSS 25 software. In determining the normality of the data, then the hypothesis established is as follows:

H0: Normally distributed data

H1: Data is not normally distributed

If on the results of the Shapiro-Wilk test (S-W) showed  $\alpha > 0.05$ , then the H0 hypothesis is accepted and vice versa, if  $\alpha < 0.05$ , then the h0 hypothesis is rejected.

3) Hypothesis Testing

Hypothesis testing in this study used SPSS 25 software and based on the results of the data normality test, using two options for different tests, namely independent sample T or Mann-Whitney U Test.

- a. Independent Sample T Test  
The Independent Sample T Test in this study was used to test the difference in the productivity of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) when the normality test results showed that the data was distributed normally.
- b. Mann Whitney U Test  
The Mann-Whitney U Test in this study was used when testing the productivity comparison of PT Angkasa Pura, I (Persero) and PT Angkasa Pura II (Persero) when the results of the normality test showed that the data was not distributed normally.

#### 4. Data Collection

The type of data used in this study is secondary data with airport research objects managed by PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) for the period 2011-2020. The source of this research data comes from the research object company. The data collection techniques used in this study are:

1. Documentation, by collecting documents that are already available. This study uses secondary data in the form of the annual financial statements of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) for the period 2011-2020 which were obtained from the websites of each company. All of the data is tabulated into Microsoft Excel software and displayed in the form of tables or images as needed. After the data is collected, the next stage is data processing.
2. Literature study, collecting data obtained from scientific books, writings, essays, and data sources from previous studies related to this research.

#### 5. Results and Discussion

##### 5.1 Descriptive Statistical Analysis

Descriptive statistical results of input and output variables used by PT Angkasa Pura I (Persero):

Table 2. Variable Input and Output Productivity of PT Angkasa Pura I (Persero)

	Mean	Std. Dev	Maximum	Minimum
<b>Number of Runways</b>	2.032.077,27	17.027,718	2.044.350	2.010.600
<b>Terminal Size Area</b>	466.258,55	139.322,07	821.998	35.696
<b>Number of Employment</b>	3.402,64	259,367	3.771	3.025
<b>Total Expenses (in thousand)</b>	3.876.781.603	1.562.687.069	5.937.866.000	1.784.787.144
<b>Number of Aircraft Movements</b>	662.467,09	123.910,087	828.672	432.864
<b>Number of Passenger</b>	70.524.674,36	18.712.877,62	96.652.313	32.711.088
<b>Total Freight</b>	368.708.814,7	54.982.267,85	457.749.380	289.678.000
<b>Total Revenue (in thousand)</b>	4.999.573.221	2.330.650.451	8.631.546.000	2.234.133.000

*Source: Processed Data, 2022*

Based on Table 2. above, the results of descriptive statistics using input and output variables during the 2010-2020 period:

- 1) The highest Number of Runway value of 2.044.350 m<sup>2</sup> is owned by the airport managed by PT Angkasa Pura I (Persero) in 2014 until now. While the lowest Number of Runway of 2.010.600 m<sup>2</sup> is owned by an airport managed by PT Angkasa Pura I (Persero) from 2010 to 2013. The average value of the Number of Runway is 2.032.077,27 with a standard deviation of 17.027.718.

- 2) The highest Terminal Size Area value is 821.998 m<sup>2</sup> owned by airports managed by PT Angkasa Pura I (Persero) in 2020, while the lowest Terminal Size Area value is 35.696 m<sup>2</sup> owned by airports managed by PT Angkasa Pura I (Persero) in 2010 and 2011. The average value of the Terminal Size Area from the airport managed by PT Angkasa Pura I (Persero) is 466.258,55 m<sup>2</sup> with a standard deviation of 139.322,07
- 3) The highest Number of Employment was 3.771 employees owned by PT Angkasa Pura I (Persero) in 2010, while the lowest Number of Employment value was 3.025 employees owned by PT Angkasa Pura I (Persero) in 2016. The average value of the Number of Employment owned by PT Angkasa Pura I (Persero) is 3.402,64 employees with a standard deviation of 259.367.
- 4) The highest Total Expenses value was Rp 5.937.866.000.000 issued by PT Angkasa Pura I (Persero) in 2019, while the lowest Total Expenses value was Rp 1.784.787.144.000 issued by PT Angkasa Pura I (Persero) in 2010. The average value of Total Expenses issued by PT Angkasa Pura I (Persero) is Rp 3.876.781.603.000 with a standard deviation of 1.562.687.069.
- 5) The Number of Aircraft Movements during 2010 to 2020 was the highest at 828.672 movements which occurred in 2018, while the number of Aircraft Movements was the lowest at 432.864 movements which occurred in 2020. The average value of The Number of Aircraft Movements is 662.467,09 movements with a standard deviation of 123.910,087.
- 6) The Number of Passengers in 2010 to 2020 was the highest at 96.652.313 passengers in 2018, while the Number of Passengers with the lowest value of 32.711.088 passengers occurred in 2020. The average value of the number of Passengers at the airport managed by PT Angkasa Pura I (Persero) is 70.524.674.36 with a standard deviation of 18.712.877,62
- 7) The highest total freight value was 457.749.380 kilogram obtained by PT Angkasa Pura I (Persero) in 2018, while the lowest Total Freight value was 289.678.000 kilogram obtained in 2010. The average value of total freight transported by PT Angkasa Pura I (Persero) during 2010 to 2011 was 368.708.814,7 kilogram with a standard deviation of 54.982.267,85 kilogram
- 8) The highest Total Revenue value was Rp 8.631.54.000.000 obtained by PT Angkasa Pura I (Persero) in 2019, while the lowest Total Revenue value was Rp 2.234.133.000.000 in 2010. The average value of Total Revenue obtained by PT Angkasa Pura I (Persero) is Rp 4.999.573.221.000 with a standard deviation of Rp 2.330.650.451.000.

The following are descriptive statistical results of input and output variables used to measure the productivity of PT Angkasa Pura II (Persero):

Table 3. Variable Input and Output Productivity of PT Angkasa Pura II (Persero)

	<b>Mean</b>	<b>Std. Dev</b>	<b>Maximum</b>	<b>Minimum</b>
<b>Number of Runways</b>	2.237.731,36	249.747,704	2.699.235	1.918.350
<b>Terminal Size Area</b>	971.571,18	74.009,779	1.062.338	874.881
<b>Number of Employment</b>	4.886	615,358	5.546	3.983
<b>Total Expenses (in thousand)</b>	4.717.080.000	2.488.389.281	8.747.210.000	1.868.030.000
<b>Number of Aircraft Movements</b>	647.968,27	132.627,801	856.886	411.164
<b>Number of Passanger</b>	82.859.526	20.720.701,59	111.454.000	35.870.000
<b>Total Freight</b>	756.291,36	85.123,495	953.606	602.421
<b>Total Revenue (in thousand)</b>	6.377.281.818	2.932.149.284	11.193.310.000	3.106.370.000

*Source: Processed Data (2022)*

Based on Table 3. above, the results of descriptive statistics using input and output variables during the 2010-2020 period:

- 1) The highest Number of Runway value of 2,699,235 m<sup>2</sup> is owned by the airport managed by PT Angkasa Pura II (Persero) in 2020 until now. While the lowest Number of Runway of 1.918.350 m<sup>2</sup> is owned by the airport managed by PT Angkasa Pura II (Persero) in 2010-2012. The average value of the Number of Runway is 2.237.731,36 m<sup>2</sup> with a standard deviation of 249.747,704
- 2) The highest Terminal Size Area value is 1.062.338 m<sup>2</sup> owned by the airport managed by PT Angkasa Pura II (Persero) in 2020, while the lowest Terminal Size Area value is 874.881 m<sup>2</sup> owned by the airport managed by PT Angkasa Pura II (Persero) in 2010-2012. The average value of the Terminal Size Area of the airport managed by PT Angkasa Pura II (Persero) is 971.571,18 with a standard deviation of 74.009,79.
- 3) The highest Number of Employment was 5.546 employees owned by PT Angkasa Pura II (Persero) in 2015, while the lowest Number of Employment value was 3.983 employees owned by PT Angkasa Pura II (Persero) in 2010. The average value of the Number of Employment owned by PT Angkasa Pura II (Persero) is 4.886 employees with a standard deviation of 615,358.
- 4) The highest Total Expenses value was Rp 8.747.210.000.000 issued by PT Angkasa Pura II (Perseo) in 2019, while the lowest Total Expenses value was 1.868.030.000.000 issued by PT Angkasa Pura II (Persero) in 2010. The average value of Total Expenses issued by PT Angkasa Pura II (Persero) is Rp 4.717.080.000.000 with a standard deviation of 2.488.389.281.000.
- 5) The Number of Aircraft Movements during 2010 to 2020 was the highest at 856.886 movements which occurred in 2018, while the lowest Number of Aircraft Movements was 411.164 movements which occurred in 2020. The average value of the Number of Aircraft Movements is 647.968,27 movements with a standard deviation of 132.627,801.
- 6) The Number of Passengers in 2010 to 2020 was the highest at 111.454.000 passengers in 2018, while the Number of Passengers with the lowest value of 35.870.000 passengers occurred in 2020. The average value of the number of Passengers at the airport managed by PT Angkasa Pura II (Persero) is 82.859.526 passengers with a standard deviation of 20.720.701,59.
- 7) The highest total freight value was 953.606 kilogram obtained by PT Angkasa Pura II (Persero) in 2018, while the lowest Total Freight value was 602.421 kilogram obtained in 2014. The average value of total freight is 756.291,36 kilogram with a standard deviation of 85.123,495
- 8) The highest Total Revenue value was Rp 11.193.310.000.000 obtained by PT Angkasa Pura II (Persero) in 2018, while the lowest Total Revenue value was Rp 3.106.370.000.000 in 2010. The average value of Total Revenue obtained by PT Angkasa Pura II (Persero) during the 2010-2020 period was Rp 6.377.281.818.000 with a standard deviation of 2.932.149.284.000.

## 5.2 Productivity Result

The following is the result of the average productivity of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) during the period 2011-2020.

Table 4. Annual Average Value in the Malmquist Index of PT Angkasa Pura I (Persero)

Year	EFFCH	TECHCH	PECH	SECH	TFPCH	Description
2011	1,000	0,837	1,000	1,000	0,837	Not Productive
2012	1,000	0,877	1,000	1,000	0,877	Not Productive
2013	1,000	0,871	1,000	1,000	0,871	Not Productive
2014	1,000	0,875	1,000	1,000	0,875	Not Productive
2015	1,000	1,840	1,000	1,000	1,840	Productive
2016	1,000	0,425	1,000	1,000	0,425	Not Productive
2017	1,000	1,134	1,000	1,000	1,134	Productive
2018	1,000	0,940	1,000	1,000	0,940	Not Productive
2019	1,000	0,843	1,000	1,000	0,843	Not Productive
2020	1,000	1,279	1,000	1,000	1,279	Productive
mean	1,000	0,934	1,000	1,000	0,934	Not Productive

*Source: Processed Data (2022)*

The Table 4 above is the result of the Malmquist Productivity Index of PT Angkasa Pura I (Persero) for the 2011-2020 period has not reached a productive stage with an average result that has a total productivity factor (TFPCH) change value of 0.934 (see Table 4.). So, it can be said to be unproductive because it has a TFPCH value < 1. This can happen because it is influenced by the TECHCH (Technology Change) factor of 0.934 as the lowest value among other factors. So, it can be concluded that PT Angkasa Pura I (Persero) is not good enough in utilizing its technology to support the company's productivity.



Meanwhile, the results of the average productivity of PT Angkasa Pura II (Persero) during the 2011-2020 period are shown through Table 5. below:

Table 5. Annual Average Value in the Malmquist Index of PT Angkasa Pura II (Persero)

Year	EFFCH	TECHCH	PECH	SECH	TFPCH	Description
2011	1,000	0,889	1,000	1,000	0,889	Not Productive
2012	1,000	0,992	1,000	1,000	0,992	Not Productive
2013	1,000	0,979	1,000	1,000	0,979	Not Productive
2014	1,000	1,094	1,000	1,000	1,094	Productive
2015	1,000	1,907	1,000	1,000	1,907	Productive
2016	1,000	0,891	1,000	1,000	0,891	Not Productive
2017	1,000	1,349	1,000	1,000	1,349	Productive
2018	1,000	0,869	1,000	1,000	0,869	Not Productive
2019	1,000	0,999	1,000	1,000	0,999	Not Productive
2020	1,000	2,088	1,000	1,000	2,088	Productive
mean	1,000	1,146	1,000	1,000	1,146	Productive

*Source: Processed Data (2022)*

Based on the results of productivity measurements during the 2011-2020 period using the Malmquist productivity Index, it shows that PT Angkasa Pura II (Persero) has an average TFPCH value >1 of 1,146. This means that PT Angkasa Pura II (Persero) is productive in managing its inputs and outputs. The average TFPCH value produced by PT Angkasa Pura II (Persero) is influenced by the technology change factor (TECHCH) of 1,146 and seen from the results of the efficiency change value (EFFCH) of 1,000. So, it can be concluded that the productivity of PT Angkasa Pura II (Persero) is not influenced by changes in efficiency (EFFCH) but is fully influenced by technological changes (TECHCH).

### 5.3 Validation

#### 5.3.1 Data Normality Test

The normality test in this section uses the average Total Factor Productivity Change (TFPCH) value from PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) through SPSS 25. The data normality test is used as a condition and reference to test hypotheses (difference tests). The data normality test uses the Shapiro-Wilk test because the data is less than 50.

Table 6. Normality Test of Average Data TFPCH of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero)

Shapiro-Wilk			
	Statistic	df	Significant
TFPCH mean PT Angkasa Pura I (Persero)	0,857	10	0,070
TFPCH mean PT Angkasa Pura II (Persero)	0,749	10	0,003

*Source: Processed Data (2022)*

Based on Table 6., it is known that the average TFPCH level of PT Angkasa Pura I (Persero) is  $0.070 > \alpha (0.05)$ , meaning that the  $H_0$  hypothesis is accepted, so that the data is distributed normally. For the significant level, the average TFPCH of PT Angkasa Pura II (Persero) is  $0.003 < \alpha (0.05)$ , meaning that the  $H_0$  hypothesis is not accepted, the data is abnormally distributed. It can be concluded that the average TFPCH value of PT Angkasa Pura I (Persero) is distributed normally, while PT Angkasa Pura II (Persero) is distributed abnormally.

#### 5.3.2 Hypothesis Testing

Based on the results of the TFPCH data normality test of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) as a whole, then for different productivity trials can use the Mann-Whitney U Test. Because the test does not have the condition that the data must be distributed normally, considering the normality test results of the

average value of PT Angkasa Pura I (Persero) are distributed normally, and PT Angkasa Pura II (Persero) is distributed abnormally. The following are the test results of the difference in the average TFPCH value of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) using the Mann-Whitney U Test.

Table 7. Test the Difference in the average TFPCH value of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero)

<b>Mann-Whitney U Test</b>			
<b>Mann-Whitney U</b>	<b>Wilcoxon W</b>	<b>Z</b>	<b>Asymp. Sig. (2-tailed)</b>
28,000	83,000	-1,663	0,096

*Source: Processed Data (2022)*

Based on the results of the TFPCH average difference test using the Mann-Whitney U Test in Table 7. above between PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) during the 2011-2020 period has an Asymp level. Sig (2-tailed) $>\alpha$  (0.05). So, the H0 hypothesis is accepted, which means that there is no significant productivity between PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero).

## 6. Conclusion

Based on the analysis and discussion of the results of research on the level of airport productivities in Indonesia managed by PT Angkasa Pura I and PT Angkasa Pura II using the Malmquist Productivity Index during the 2011-2020 period by conducting productivity testing, it can be concluded as follows:

1. MPI results show that the average TFPCH value of PT Angkasa Pura I is not too high. This means that PT Angkasa Pura I is not productive in managing its inputs and outputs, this happens because of the use of less-than-optimal technology in managing operational activities at airports managed by PT Angkasa Pura I. However, PT Angkasa Pura I has been quite efficient in managing its inputs and outputs because the average value of EFFCH is standard.
2. MPI results show that the average TFPCH value produced by PT Angkasa Pura II is high. This means that PT Angkasa Pura II is productive in managing its inputs and outputs. This productivity occurs because PT Angkasa Pura II is efficient in managing its inputs and outputs and is supported using optimal technology in managing its inputs and outputs.
3. Based on the comparison between the productivity of PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero), there are differences in the level of productivity. Which can be said that PT Angkasa Pura II is more productive than PT Angkasa Pura I in managing its inputs and outputs because the results of measuring the level of productivity show that PT Angkasa Pura I is not productive, and PT Angkasa Pura II is productive in managing its inputs and outputs. Even though, the result of different test TFPCH mean show that the difference between PT Angkasa Pura I (Persero) and PT Angkasa Pura II (Persero) is not significant.

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