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EVALUATING FINANCIAL PERFORMANCE WITH MINIMUM SPANNING TREE APPROACH: AN APPLICATION IN AIRLINES COMPANIES

Faruk DAYI - Tolga ULUSOY***

ABSTRACT

The rapid development of technology increased aircraft production and airlines that is alternative to land, rail, sea routes and a faster means of transport have an important position in the World. Airlines companies increasing their share day by day become an important sector that has continued to grow. The purpose of the study is to evaluate success of World Airlines in terms of financial performance. In our study, 19 airlines company's data were used for the period 2008-2014. It is used various ratios calculating to evaluate financial performance. Data set include accessible financial statement of companies. MST approach method including ratio analysis is used. Financial performance indicators are Accounts Receivables Turnover Rate, Average Collection Period of Receivables, Inventory Turnover Average Inventory Turnover Period, Asset Turnover, Net Profit Ratio, Return on Assets Ratio and Return on Equity. After calculating ratios, given a brief topology of calculated ratios of 19 airline companies that have been analyzed for he period 2008-2014 applying MST (minimal spanning tree) and Fourier analysis. Relations between companies with ratio analysis have been analyzed using the Minimum Spanning Tree (MST) approach, which is frequently used in econophysics discipline. Verifications of the series have been tested with the Fourier distribution. The results showed that Turkish Airlines are grown in terms of profitability, total assets and annual sales every passing year.

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STRUCTURED ABSTRACT

The rapid development of technology increased aircraft production and airlines that is alternative to land, rail, sea routes and a faster means of transport have an important position in the World. Airlines companies increasing their share day by day become an important sector that has continued to grow. The purpose of the study is to evaluate success of Airlines in terms of financial performance. Relations between companies with ratio analysis have been analyzed using the Minimum Spanning Tree (MST) approach, which is frequently used in econophysics discipline. Verifications of the series have been tested with the Fourier distribution.

There is a cash flow cycles in all business regardless of whether it is the service or production business. Cash flows of the business, the quality and the competitive structure of the industry affect the management structure of the company (Bertoneche and Knight, 2001). Because every profitable business is not financially successful at the same time. As many businesses, which have net profit for the period cannot manage the cash assets, they go into liquidation, even go bankruptcy. In this direction, the main of this study is to be measured financial performance of approximately 180 airline passenger transport companies that operates in the world through extent of operating leverage in the period of 2008-2014. But the data of only 19 companies operating in the world has been obtained. Data set include accessible financial statement companies for the period 2008-2014. Financial performance indicators are Accounts Receivables Turnover Rate, Average Collection Period of Receivables, Inventory Turnover Average Inventory Turnover Period, Asset Turnover, Net Profit Ratio, Return on Assets Ratio and Return on Equity.

After calculating ratios, given a brief topology of calculated ratios of 19 airline companies that have been analyzed for he period 2008-2014 applying MST (minimal spanning tree) and Fourier analysis. This section gives a description, methodology with discounting factor and correlation function between calculated ratios of companies. Based on airline industries the main question of this section indicates if there is any strong interrelationships or not. Economic activities of industry firms may give useful information of the airline industry combining ratio analysis and metrics.

In this study is to evaluate financial performance of airline companies. MST approach method including ratio analysis is used. Even if many companies have not strong and enough equity, they are able to have the high number of aircraft with leasing. When considered from this point of view, seeing as increasing in the number of aircraft will increase sales revenue, it is thought that there are significant changes at the operating leverage ratio. However, when the results are examined, although the increase in sales is commensurate with the increase in the number of aircraft, it is seen that this does not cause much of change in the return on equity. The important expenditure items such as manpower cost and fuel cost raise the costs of the company. Furthermore, the risk of exchange also causes a significant decline in sales revenue of the companies.

The main aim of this research is to analyze airline companies with ratios. Analyzed trees we would like to check that airline companies which has huge number of passengers tend to cluster. But it can not. The MSTs were obtained from an algorithm in graph theory for ratios. Therefore, it discovers a subset of the edges. Later, it creates a tree that inclusive every top point. Thus the total weight of all the edges in the tree is minimized. The sixth cluster is composed of namely Air China, AMR Cooperation, Delta Airlines, Lufthansa, Thomas Cook Group. Air China, Cathay Pasific and British Airways seem to have central positions in Minimum Spanning Forest (MSF) for the average collection period of receivables via inventory turnover results. China Eastern, KLM, Qantas Airways and Turkish Airlines seem to have central positions in Minimum Spanning Forest (MSF) using the variables of their inventory turnover results and inventory periods. The fourth cluster is consisted of AMR Coperation, Lufthansa and United Airlines. KLM, Lufthansa and United Airlines seem to have central positions in Minimum Spanning Forest (MSF) inventory periods of the companies (day) via asset turnover results of companies. The third cluster is consisted of Air France, ANA Holdings, Qantas Airways, Thomas Cook Group, US Airways. Air France-KLM and Qantas have the most similar firms. Comparison of turnovers and profitabilities side we obtain Cathay Pasific and Lufthansa gives minimum distanced and closed to each other. Cathay Pasific and Air France-KLM have central positions in Minimum Spanning Forest (MSF) for net profitability ratios via return on assets ratio results. The fourth cluster is consisted of Air France-KLM, ANA Holdings, Thomas Cook Group in one side; Air France-KLM, US Airways and Qantas create have the most similar firms. Return on assets and profitabilities side we obtain Turkish Airlines has the most significant central position in MSF. The fifth cluster is consisted of Air France-KLM, ANA Holdings, Qantas Airways, Emirates, United Airlines have the most similar firms. Comparison of returns on assets and return on equities side we obtain Turkish Airlines gives minimum distanced and closed to each other. Turkish Airlines has the highest return on assets after Emirates. As a result even if financial performance follows an increasing successful course in civil aviation sector in 7-year period, it is noticeable that there are serious problems in sector. It is thought that Turkish Airlines show a high performance compared to other companies.

Keywords: Civil aviation; Ratio analysis; Minimum Spanning Tree

MİNİMUM KAPSAYAN AĞAÇ YÖNTEMİ KULLANILARAK FİNANSAL PERFORMANS KARŞILAŞTIRILMASI: HAVAYOLLARI ŞİRKETLERİNDE BİR UYGULAMA

ÖZET

Teknolojinin hızla gelişmesiyle uçak üretimi artmış, havayolu ulaşımı, kara, demiryolu, deniz yollarından daha hızlı ulaşım sağlayarak havayolu ile ulaşımın öneminin dünyada artmasını sağladı. Havayolu şirketleri sektördeki paylarını her geçen gün arttırarak önemli bir sektör haline gelmiş ve sektörün büyümesi devam etmiştir.

Çalışmanın amacı, dünyadaki havayolu şirketlerinin finansal performansları açısından başarılarını değerlendirmektir. Finansal performansı değerlendirmek için çeşitli rasyolar kullanılmıştır. Havayolu şirketlerinin 2008-2014 dönemine ait finansal tablolarından yararlanılarak rasyolar hesaplanmıştır. Uygulamada oran analizinden elde edilen veriler Minimum Spanning Tree yönteminde kullanılması çalışmaya farklılık katmaktadır. Finansal performans göstergesi olarak alacak deviz hızı, alacakların ortalama tahsil süresi, stok devir hızı, stokların devir süresi, aktif devir hızı, net kar marjı, aktif karlılık oranı ve özsermaye karlılık oranı kullanılmıştır. 19 havayolu şirketinin 2008-2014 dönemi rasyoları, Minimum Spanning Tree (MST) yönteminde kullanılarak analiz yapılmıştır. Oran analizine sahip şirketler arasındaki ilişkiler, ekonofizik disiplinde sıklıkla kullanılan Minimum Spanning Tree (MST) yaklaşımı kullanılarak analiz edilmiştir. Serinin doğrulamaları Fourier dağılımı ile test edilmiştir. Sonuçlar, havayolu şirketlerinin finansal peformanslarını artırdıklarını ve Türk Hava Yollarının her geçen yıl karlılık, toplam varlık ve satış gelirleri açısından büyüdüğünü göstermektedir.

Anahtar Kelimeler: Sivil Havacılık, Rasyo Analizi, Minimum Örten Ağaç.

1. Introduction

The civil aviation sector has begun developing after World War II. No longer traveling by plane has been possible by making the airport in many country and city. Although traveling by plane is expensive, aircraft comfort and the short journey time lead to become a preferred means of transportation. Thus the civil aviation sector in the World is rapidly developed for recent years (Merkert and Morrell, 2012). As the quality of security and service increases, the number of passengers increases. Because passengers prefer for air travel when they are safe, good quality service and low price of ticket (Jou et al.,2008). But when we look at the situation in terms of airline companies, it is important for they to determine the route for cost-effective flight planning (Gillen and Mantin, 2009). As the number of aircraft increased, the total assets of the companies increased. So there has been a need to assess financial performance of airlines operated in the World. This study tests the ratios on topology of the airlines companies that have been analyzed for the same period, applying the concept of minimal spanning tree (MST) analysis. A derivative of hierarchical organization and minimal-spanning for periods and the results were used to confirm the validation of the semantics applied (Ulusoy et.al., 2012).

2. Literature

The rapid development of technology increased aircraft production and air transport that is alternative to land, rail, sea routes and a faster means of transport have an important position in the World. Airline passenger transports increasing its share in passenger transport day by day become an important sector that has continued to grow. However it is developing in the World, our national civil aviation company Turkish Airlines, has founded in 1933 (Yurtoglu, 2016), has been closely following developments.

Civil aviation sector increase its share of the economy by growing with every passing year with the growth of the global economy, change of the passengers' travel habits, decline of fuel prices and increasing travel requirements. Thanks to the advancement of technology, producing aircraft, which consume less fuel, reduce the costs of the companies and thus companies may be sell flight tickets at more affordable price because of lower fuel costs.

When IATA's 2015 assessment report that is about the world civil aviation sector was examined, the total revenue in the sector amounted to 643 billion dollars in 2011 and it rose to 758 billion dollars by the end of 2014 (IATA,2015). In addition when examined total net profit of sector, net profit that was 8.3 billion dollars in 2011 increased to $ 17.8 billion in 2014. The total number of flights in the sector was 33.4 million in 2014 and total of 3.31 billion passengers are transported on these flights. As for staff numbers, which were employed in World civil aviation industry, were approximately 58 million people in 2014. The share of airline companies in the World service sector is increasing day by day. Therefore, it is thought that the analysis of the financial performance in the civil aviation sector will be beneficial (Kendirli and Kaya, 2016).

Performance is process of determining effectiveness or/and productivity of retrospective action of the companies. For example; customer satisfaction regarding the products and services of a company is a measure of the effectiveness or efficiency of that company (Cui and Li, 2017). Therefore, companies need to establish good performance evaluation systems to increase the existing success of the company. Performance evaluation system allows to conscious move about taken decisions. Because, a successful performance measurement system is to quantify effectiveness and efficiency of the actions taken in the past through data collection, compilation, analysis and interpretation (Nelly et. al., 2002). Ratio analysis, economic added value and data envelopment analysis method are usually used in the measurement of financial performances in service businesses. Ratio analysis in measuring financial performance in an airline company gives meaningful results (Feng and Wang, 2000). Data envelopment analysis is often used to measure financial performance for airlines companies (Bilotkach and Lakew,2014). Especially by Gillen and Lall (1997), it was desired to use it as a different technique in measuring financial performance. Otherwise Cui and Li (2017)are used the method Dynamic Epsilon Based Measure (DEBM) in the studies to measure financial performance. In addition, performance analysis is also done using Malmquist index by Barros and Couto (2013) and Assaf (2011).

Ratio analysis is generally preferred to measure financial performance of company (Horne and Wachowicz, 2008). At this point the information on the financial statements is quite high in order to obtain successful results in the analysis (Karwowski, 2016). Otherwise, ratio analysis may not yield meaningful results. Financial ratios are used to measure of financial position of a company. Bertoneche and Knight (2001) categorise financial ratios in four categories. Liquidity and profitability ratios of them are used to measure financial performance.

Prof. Stanley prescribed the Econophysics in 1997 and in 1999 (Mantegna, 2009)(Mantegna and Stanley,2000). Intra-Physics&Economics models developed for earthquake prediction. Econophysics has made empirical contributions for social and economic World. Econophysics has also begun to cope with short supply of data and other areas of economy where it is less reliable (Pries, 2011)(Aste et al.,2010)(Preis et. al.,2010)(Preis et. al.,2011)(Sornette et. al., 2009)(Salvatore et al., 2008)(Coelho, et. al., 2007)(Sun et.al., 2011)(Silva, 2005).

Chen and Shimerda (Chen and Shimerda, 1981) make analysis for seven financial variables. Oum and Yu (1998), are analyzed that the profitability of airline companies, taking into account productivity and costs. Feng and Wang (2000) state that most of studies are made on the basis of operational information and the studies measured financial performance are not much. Pearson and others (2003) make analysis for the financial performance of the airline passenger companies with financial and non-financial data. Baker and others (2005) made an analysis of financial performance using ratio analysis. Wang (2008) makes ratio analysis for airlines via fuzzy logic decision-making method. Barros and Peypoch (2009) have used data envelopment analysis for airlines. They find that management of company is very important for performance of financial. Pires and Fernandes (2012) examine the financial efficiency of 42 airlines from 42 countries in 2001 and 2002. Zou and Hansen (2012) analyze the effect of performance in airline is being investigated via methods of "Statistical Cost Estimation". Bilotkach and Lakew (2014) are examined whether ticket price is a more important

market power than route dominance in the US airline industry. Jain and Natarajan (2015) evaluate via data envelopment analysis method for airlines companies in India of 2006-2010. Li and et al. (2015) have made the efficiency of airline companies under three categories: operation, service and sales. Saranga and Nagpal (2016) use via DEA methods for efficiency data set including 2005-2013 in airlines. Teker and others (2016) analyze the financial performance of 20 airlines with the largest asset size operating globally for the period 2011-2014. Scotti and Volta (2017) examine Bayesian estimation of cost function and the change of airway profitability. Dayi ve Esmer (2017) evaluate for financial performance via ratio analysis mehods European airlines.

3. Methodology

There is a cash flow cycles in all business regardless of whether it is the service or production business. Cash flows of the business, the quality and the competitive structure of the industry affect the management structure of the company (Bertoneche and Knight, 2001). Because every profitable business is not financially successful at the same time. As many businesses, which have net profit for the period cannot manage the cash assets, they go into liquidation, even go bankruptcy. So the main objective is to be measured financial performance of approximately 180 airline passenger transport companies that operates in the world through extent of operating leverage in the period of 2008-2014. But the data of only 19 companies operating in the world has been obtained and listed in Table 1. Therefore 19 airline companies is used in the study. Data is calculated from financial statement for companies. Data set consists of 1064 data regarding 8 indicators of 19 companies. Financial performance indicators are Accounts Receivables Turnover Rate, Average Collection Period of Receivables, Inventory Turnover Average Inventory Turnover Period, Asset Turnover, Net Profit Ratio, Return on Assets Ratio and Return on Equity.

Table 1: List of Airlines Companies

Numbers	Companies of Airline
1	Air Berlin
2	Air China
3	Air France – KLM
4	AMR Corporation
5	ANA Holdings
6	British Airways
7	Cathay Pasific
8	China Eastern
9	China Southern Airlines
10	Delta Airlines
11	Emirates
12	KLM
13	Lufthansa
14	Qantas Airways
15	Southwest Airlines
16	Thomas Cook Group
17	Turkish Airlines
18	United Airlines
19	US Airways

Operating ratios are used that effectiveness and productivity. While a rising trend of the receivables turnover by years shows that company is successful in the collection of receivables, a falling trend shows that company has a trouble in the collection of receivables and a part of capital is used for the financing of receivables. Companies are expected to be high receivable turnover. Because a high ratio states that cash assets are more and these companies may face less cash flow problems. No matter how short the average collection period of receivables shows that the collection of receivables of the company is so effective. However, if the average collection period of receivables is high, it means that company is not effective in the collection of receivables. Inventory turnover ratio indicates how many times inventory is "turned" in other words "renewed" during the year. It means that the more the ratio is high, the more the company is very effective the use of its inventory. However, it is also important cost of inventory, which is hold here. Because, it is easier to rotate low-priced stocks compared to high-priced inventory. A high inventory turnover period may indicate that the liquidation powers of company's inventories are high. Businesses with high level of competitiveness have generally high inventory turnover ratios. The shorter the average turnover period of inventories, the lower the cost of the inventories, which are held, will be. Therefore businesses attach importance to the stock policy in order to reduce the cost and to be turned into cash of inventories. Credit institutions also prefer to be high inventory turnover ratio and low average inventory turnover period. Asset turnover ratio is the ratio that shows how efficiently a company can use its assets. High turnover ratio means that the company assets are used more efficiently. The more this ratio is high the more company assets are used efficiently. If the ratio is low, it shows that the company does not use its assets effectively and efficiently.

Profitability ratios measure productivity. They are very important about success for past years of company. Net profitability ratio shows the percentage share of the net profit in the sales. Net profitability ratio is calculated by dividing the remaining net profit, obtained via deducting all the expenses from all the income, by net sales. This ratio is one of the most commonly used ratios to identify whether the company is successful. Return on assets ratio shows whether the assets of the business are used efficiently. Return on equity ratio is used to measure the equity efficiency of businesses. Return on equity ratio is considerably important, especially in terms of partners.

After calculating ratios, given a brief topology of calculated ratios of 19 airline companies that have been analyzed for he period 2008-2014 applying MST (minimal spanning tree) and Fourier analysis. This section gives a description, methodology with discounting factor and correlation function between calculated ratios of companies. Based on airline industries the main question of this section indicates if there is any strong interrelationships or not. Economic activities of industry firms may give useful information of the airline industry combining ratio analysis and metrics.

Suppose Y(t) one of the calculated financial ratio at time t. Beginning to investigate the price changes like (Mantegna, 1999) (Mantegna and Stanley, 2000).

$$Z(t) \equiv Y(t+\Delta t) - Y(t) \qquad (1)$$

with a discounting factor [28].

$$Z_D(t) \equiv [Y_{(t+\Delta t)} - Y_{(t)}]\, D_{(t)} \qquad (2)$$

$D_{(t)}$ is a deflation factor (discounting factor) and many scientists assume that it is unpredictable over the long term. Inflaction of the years may be taken over $\Delta(t)$ from above $R_{(t)}$ can be written as

$$\frac{Y_{(t+\Delta t)}-Y_{(t)}}{Y_{(t)}} = \frac{Z_{(t)}}{Y_{(t)}} \qquad (3)$$

From eq. (3) $R_D(t)$ can be written and calculated as follows.

$$\frac{[Y_{(t+\Delta t)} * D_{(t+\Delta t)} - Y_{(t)} * D_{(t)}]}{Y_{(t)} * D_{(t)}}$$

Replace ϕ with discounting factor Δ(t) and $R_{(t)} \equiv$

$$\frac{Y_{(t+\Delta t)} * \phi_{(t+\Delta t)}}{Y_{(t)} * \phi_{(t} - \frac{Y_{(t)} * \phi_{(t)}}{Y_{(t)} * \phi_{(t)}}$$

$RD(t) \equiv \ln[Y_{(t+\Delta t)} * \phi_{(t+\Delta t)}] - \ln[Y_{(t)} * \phi_{(t)}]$

taking Δt as 1 year above equation becomes

$RD(t) \equiv \ln[Y_{(t+1)} * \phi_{(t+1)}] - \ln[Y_{(t)} * \phi_{(t)}]$

Vector of time series of log returns with discounted CDij

$$x = \frac{< R_\Delta{}^i * R_\Delta{}^j >< R_\Delta{}^i >< R_\Delta{}^j}{\sqrt{(< R_\Delta i^2 > - < R_\Delta{}^i >^2)(< R_\Delta j^2 > - < R_\Delta{}^j >^2)}}$$

fullfills the 3 axioms of Euclid [28][29]

i) Cdij=0 if i=j

ii) Cdij= Cdji

iii) Cdij≤ Cdik + Cdkj

4. Findings

The first of the part are calculated 8 ratios in 2008-2014 period of 19 companies. In the second topology of the MST is organized and tested with a Fourier series. In this part, we introduce the MSTs using groups of 19 airline companies. Engaged connections between the companies were analyzed by MSTs using MATLAB. The main aim of this research is to analyze airline companies with ratios. Analyzed trees we would like to check that airline companies which has huge number of passengers tend to cluster. But it can not. The MSTs, in Figs. 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, and 7-8 were obtained from an algorithm in graph theory for ratios. Statistical reliabilities is tested on using Fourier distribution. If the values are close to one, the statistical reliability of the link is quite high (Silva, 2005). Otherwise, the statistical reliability is low (Silva, 2005)(Ulusoy, et.al., 2012).

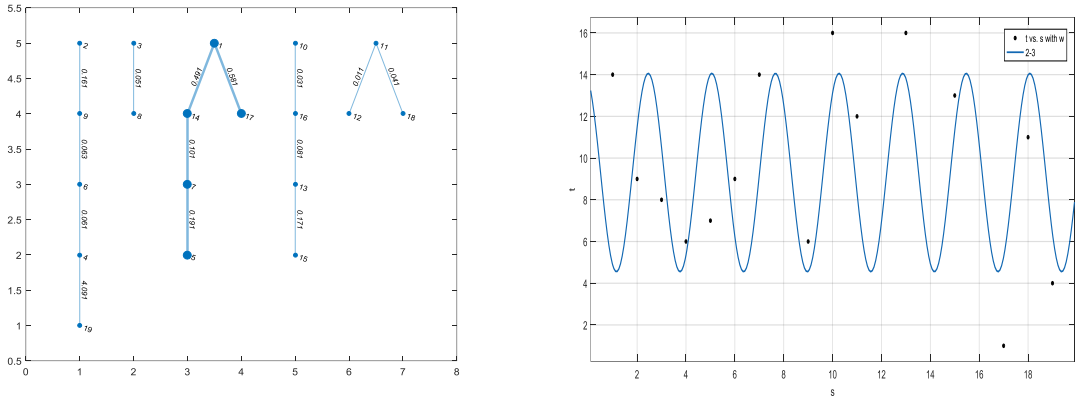

Figure 1-2: Receivable turnover ratios via the average collection period of receivables.
General model Fourier1: f(x) = a_0 + a_1*cos(x*w) + b_1*sin(x*w) where x is normalized by mean 9.333 and std 5.99 Coefficients (with 95% confidence bounds): a_0 = 9.306 (7.09, 11.52) a_1 = -2.976 (-6.685, 0.7336) b_1 =3.709 (0.6466, 6.771) w =14.47 (13.67, 15.28) Goodness of fit: SSE: 1326 R-square: 0.5312 Adjusted R-square: 0.4033 RMSE: 10.98

In Fig. 1-2, between years 2008 and 2014 identified five clusters of companies are identified. The first cluster (highlighted tree) is composed of namely Air Berlin, ANA Holdings, Cathay Pasific, Qantas Airways, Turkish Airlines. Air Berlin, Emirates and British Airways seem to have central positions in Minimum Spanning Forest (MSF) .

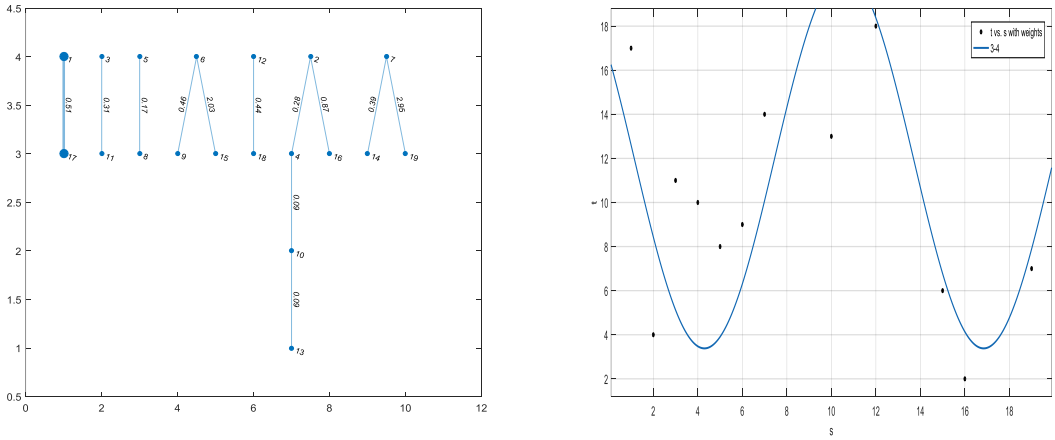

Figure 2-3: T**he average collection period of receivables via inventory turnover results.**
General model Fourier1: f(x) = a_0 + a_1*cos(x*w) + b_1*sin(x*w) Coefficients (with 95% confidence bounds): a_0 =11.93 (8.446, 15.41) a_1 =4.69 (-0.8274, 10.21) b_1 = -7.144 (-13.55, -0.7406) w = 0.5007 (0.4487, 0.5528) Goodness of fit: SSE: 54.2 R-square: 0.6435 Adjusted R-square: 0.5097 RMSE: 2.603

In Fig. 2-3, between years 2008 and 2014 identified seven clusters of companies are identified. The sixth cluster is composed of namely Air China, AMR Cooperation, Delta Airlines, Lufthansa, Thomas Cook Group. Air China, Cathay Pasific and British Airways seem to have central positions in Minimum Spanning Forest (MSF).

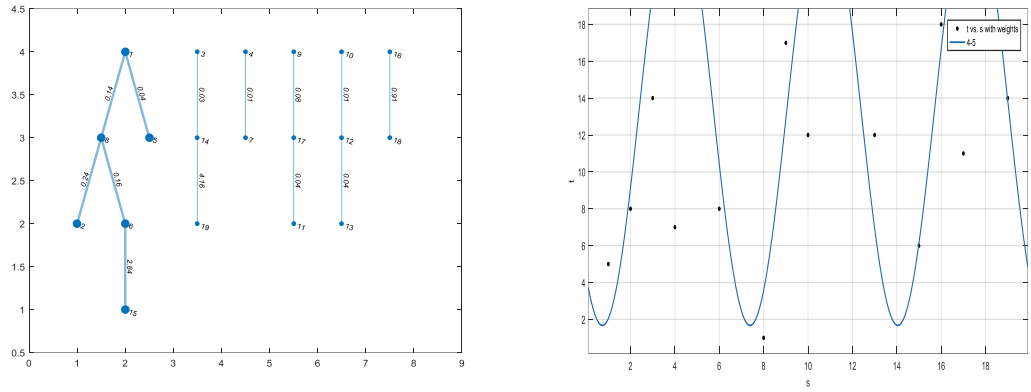

Figure 3-4: Inventory turnover results of the companies via inventory periods of the companies (day)
General model Fourier1 f(x) = a_0 + a_1*cos(x*w) + b_1*sin(x*w) Coefficients (with 95% confidence bounds): a_0 = 13.46 (11.84, 15.07) a_1 = -9.072 (-14.38, -3.76) b_1 = -7.524 (-13.15, -1.9) w = 0.944 (0.9096, 0.9784) Goodness of fit: SSE: 19.48 R-square: 0.8885 Adjusted R-square: 0.8514 RMSE: 1.471

In Fig. 3-4, between years 2008 and 2014 identified six clusters of companies are identified. The first cluster is composed of namely Air China, Air Berlin, ANA Holdings, British Airways, Southwest Airlines. China Eastern, KLM, Qantas Airways and Turkish Airlines seem to have central positions in Minimum Spanning Forest (MSF) using the variables of their inventory turnover results and inventory periods.

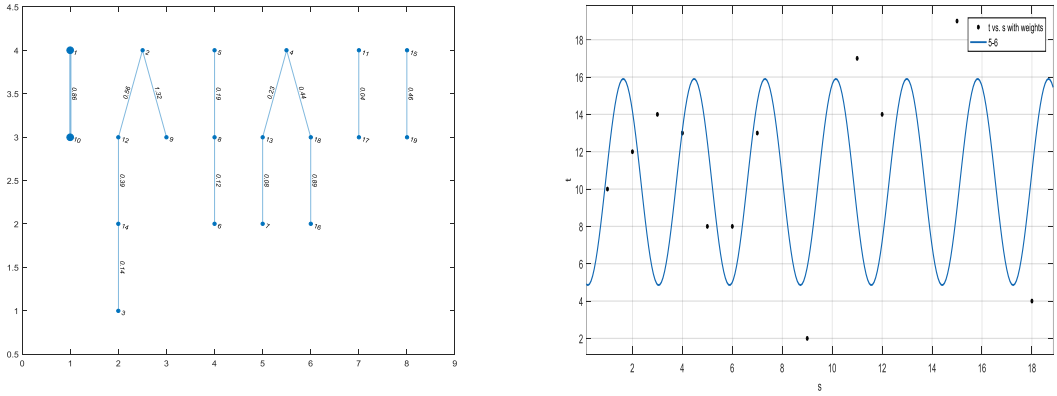

Figure 4-5: Inventory periods of the companies (day) via asset turnover results of companies
General model Fourier1: f(x) = a_0 + a_1*cos(x*w) + b_1*sin(x*w) Coefficients (with 95% confidence bounds): a_0 =10.38 (5.994, 14.76) a_1 =-4.922 (-12.55, 2.703) b_1 =-2.517 (-9.996, 4.963) w = 2.213 (2.072, 2.355) Goodness of fit: SSE: 134 R-square: 0.3639 Adjusted R-square: 0.1519 RMSE: 3.858

In Fig. 4-5, between years 2008 and 2014 identified six clusters of companies are identified. The second one and the fourth one seem much more significant ones. The second cluster is composed of namely Air China, Air France-KLM China Southeastern Airlines, KLM, Qantas. The fourth cluster is consisted of AMR Coperation, Lufthansa and United Airlines. KLM, Lufthansa and United Airlines seem to have central positions in Minimum Spanning Forest (MSF).

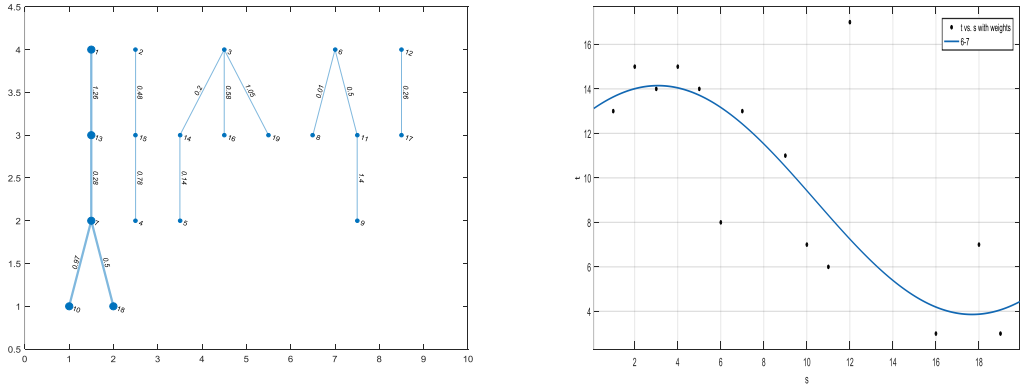

Figure 5-6: Asset turnover results of companies via net profitability ratios
General model Fourier1: f(x) = a_0 + a_1*cos(x*w) + b_1*sin(x*w) Coefficients (with 95% confidence bounds): a_0 = 9.003 (7.124, 10.88) a_1 = 4.052 (-0.6979, 8.802) b_1 =3.167 (-3.918, 10.25) w = 0.2152 (0.04845, 0.382) Goodness of fit: SSE: 42.44 R-square: 0.7434 Adjusted R-square: 0.6665 RMSE: 2.06

In Fig. 5-6, between years 2008 and 2014 identified five clusters of companies are identified. The first one and the third one seem much more significant ones. The first cluster is composed of namely Air Berlin, Cathay Pasific, Delta Airlines, Lufthansa and United Airlines. The third cluster is consisted of Air France, ANA Holdings, Qantas Airways, Thomas Cook Group, US Airways. Air France-KLM and Qantas have the most similar firms. Comparison of turnovers and profitabilities side we obtain Cathay Pasific and Lufthansa gives minimum distanced and closed to each other. Cathay Pasific and Air France-KLM have central positions in Minimum Spanning Forest (MSF).

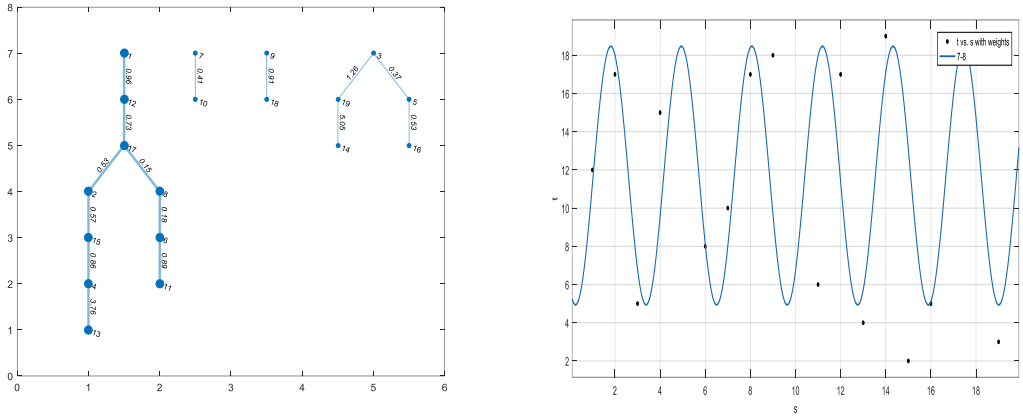

Figure 6-7: Net profitability ratios via return on assets ratio results
General model Fourier1: f(x) =a_0 + a_1*cos(x*w) + b_1*sin(x*w)Coefficients (with 95% confidence bounds): a_0 =11.7(8.378, 15.03) a_1 = -5.924(-12.22, 0.3758) b_1 =-3.288(-12.16, 5.587) w =2.01(1.869, 2.15) Goodness of fit: SSE: 346.8 R-square: 0.5653 Adjusted R-square: 0.4468 RMSE: 5.615

In Fig. 6-7, between years 2008 and 2014 identified four clusters of companies are identified. The first one and the fourth one seem much more significant ones. The first cluster is composed of namely Air Berlin, Air China, AMR Cooperation, KLM, Lufthansa, Southwest Airlines, Turkish Airlines. The fourth cluster is consisted of Air France-KLM, ANA Holdings, Thomas Cook Group in one side; Air France-KLM, US Airways and Qantas create have the most similar firms. Return on assets and profitabilities side we obtain Turkish Airlines has the most significant central position in MSF.

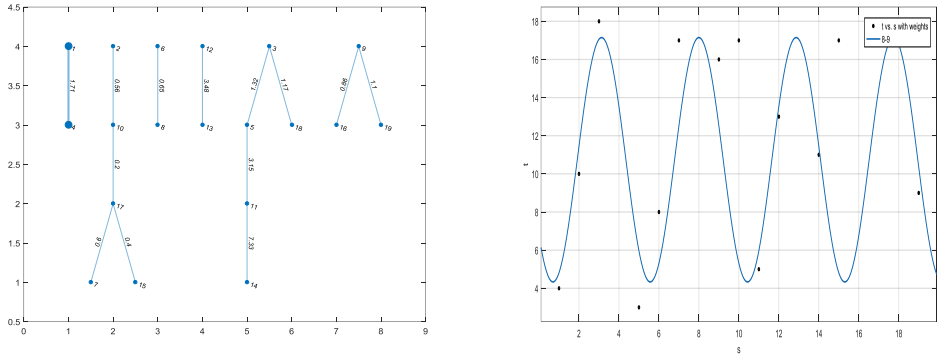

Figure 7-8: Return on assets ratio results via return on equities
General model Fourier1: f(x) = a_0 + a_1*cos(x*w) + b_1*sin(x*w) Coefficients (with 95% confidence bounds): a_0 =10.74 (8.547, 12.93) a_1 =-3.988 (-10.75, 2.77) b_1 =-5.018 (-10.84, 0.8004) w =1.291(1.186, 1.395) Goodness of fit SSE: 136.3 R-square: 0.6688 Adjusted R-square: 0.5584 RMSE: 3.892

In Fig. 7-8, between years 2008 and 2014 identified six clusters of companies are identified. The second one and the fifth one seem much more significant ones. The second cluster is composed of namely Air China, Cathay Pasific, Delta Airlines, Southwest Airlines and Turkish Airlines. The fifth cluster is consisted of Air France-KLM, ANA Holdings, Qantas Airways, Emirates, United Airlines have the most similar firms. Comparison of returns on assets and return on equities side we obtain Turkish Airlines gives minimum distanced and closed to each other.

5. Conclusion

In this study is investigated airline financial performance. MST approach method including ratio analysis is used. Even if many companies have not strong and enough equity, they are able to have the high number of aircraft with leasing. When considered from this point of view, seeing as increasing in the number of aircraft will increase sales revenue, it is thought that there are significant changes at the operating leverage ratio. However, when the results are examined, although the increase in sales is commensurate with the increase in the number of aircraft, it is seen that this does not cause much of change in the return on equity. The important expenditure items such as manpower cost and fuel cost raise the costs of the company.

The main aim of this research is to analyze airline companies with ratios. Analyzed trees we would like to check that airline companies which has huge number of passengers tend to cluster. But it can not. The MSTs were obtained from an algorithm in graph theory for ratios. Therefore, it discovers a subset of the edges. Later, it creates a tree that inclusive every top point. The sixth cluster is composed of namely Air China, AMR Cooperation, Delta Airlines, Lufthansa, Thomas Cook Group. Air China, Cathay Pasific and British Airways seem to have central positions in Minimum Spanning Forest (MSF) for the average collection period of receivables via inventory turnover results. China Eastern, KLM, Qantas Airways and Turkish Airlines seem to have central positions in Minimum Spanning Forest (MSF) using the variables of their inventory turnover results and inventory periods. The fourth cluster is consisted of AMR Coperation, Lufthansa and United Airlines. KLM, Lufthansa and United Airlines seem to have central positions in Minimum Spanning Forest (MSF) inventory periods of the companies (day) via asset turnover results of companies. The third cluster is consisted of Air France, ANA Holdings, Qantas Airways, Thomas Cook Group, US Airways. Air France-KLM and Qantas have the most similar firms. Comparison of turnovers and profitabilities side we obtain Cathay Pasific and Lufthansa gives minimum distanced and closed to each other. Cathay Pasific and Air France-KLM have central positions in Minimum Spanning Forest (MSF) for net profitability ratios via return on assets ratio results. The fourth cluster is consisted of Air France-KLM, ANA Holdings,

Thomas Cook Group in one side; Air France-KLM, US Airways and Qantas create have the most similar firms. Return on assets and profitabilities side we obtain Turkish Airlines has the most significant central position in MSF. The fifth cluster is consisted of Air France-KLM, ANA Holdings, Qantas Airways, Emirates, United Airlines have the most similar firms. Comparison of returns on assets and return on equities side we obtain Turkish Airlines gives minimum distanced and closed to each other. Turkish Airlines has the highest return on assets after Emirates. Financial performance follows an increasing successful course in civil aviation sector in 7-year period. It is thought that Turkish Airlines show a high performance compared to other companies.

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