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Balanced scorecard based performance measurement of European airlines using a hybrid multicriteria decision making approach under the fuzzy environment

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ABSTRACT

The purpose of this study is to evaluate the performance of the European airlines, using a balanced scorecard perspective. Within this scope, a hybrid multi-criteria approach was used by combining the Fuzzy DEMATEL, Fuzzy ANP, and MOORA methods. The results demonstrate that customer dimensions and profit per customer are the most significant key factors in the balanced scorecard perspective. Additionally, the airline companies with the largest profit (per employee) and highest number of passengers and flights (per employee) had the best scores in the multidimensional performance results. Furthermore, the airline companies with the highest profitability and efficiency are more successful than other companies. Therefore, we recommend European airlines to focus on these aspects in order to improve their performance. This study makes an important contribution to literature by helping to solve a significant problem in the market with the proposed methodology.

1. Introduction

With the impact of globalization on the international airline sector, the air transportation industry has become essential for international trade. Naturally, as international business and trade have increased, the demand for growth within the air sector has risen as well. Similarly, the tourism market has also been impacted on a global scale, resulting in tourism soaring across the globe and the demand for more competition and options within the airline transportation sector (Debbage, 1994).

European airline companies, in particular, are important in the sector because Europe is a logistically significant destination. According to a 2015 European Commission report, it has more than 400 airports and employs more than 5.1 million people. Furthermore, the biggest airlines of the world, such as Air France and Lufthansa, are in Europe. In addition, according to the October 2016 IATA report, Europe has 26.7% of the air passenger market. Similarly with respect to the international air passenger market, Europe has a 23.8% share, which is the highest ratio in the market and an international revenue passengers kilometers growth of 5.7% during this same period.

However, according to the 2013 European Commission report, high competition in the airline transportation sector began to negatively affect the European airline market. As a result, the European Union developed an aviation strategy in 2015 in order to increase the competitive advantage of European airline companies, and their future market shares, thereby boosting economic growth and employment rates (Alam et al., 2016).

Because of the contributions of airline sector to the economy, measuring financial performance of the airlines sector is critical for the competitive market. For this purpose, financial analysis must be performed in order to understand whether these companies are successful or not. However, the data taken from financial reports gives only limited information about the companies and non-financial performance measurement determinants should also be taken into consideration while analyzing the performance of the airline (Perera et al., 1997).

The performance of European airline companies has attracted the attention of many researchers, most of which tried to evaluate performance by using methods such as regression, Granger causality analysis, and vector error correction methods. Generally, though, analysis has focused around the financial data of these

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companies. Clearly, a study in which an original method is used and non-financial performance in addition to the financial data is should be examined.

This study aims to analyze the performance of 9 European airline companies using multidimensional factors based on balanced scorecard variables. Balanced scorecard has become a very popular approach with respect to performance measurement, especially after the rise of globalization. It considers four different perspectives: finance, customer, internal process and learning and growth. In other words, the financial and non-financial variables should be used to provide more meaningful results than a conventional performance perspective. Another important point of this study is to use the hybrid multi-criteria decision-making approach by using three different methods (Fuzzy DEMATEL, Fuzzy ANP, and MOORA). This situation increases the originality of this study with respect to the methodology.

The paper is organized as follows: after introduction part, we give information about global competition in European airline industry. In the third part, we explain similar studies in the literature. Furthermore, the forth part provides multidimensional approach to performance measurement in airline industry. In the fifth part, we give information about the models used in the analysis. Moreover, sixth part explains the analysis for European airline industry. Finally, the results of the analysis are given at conclusion.

2. Global competition in the European airline industry

Globalization is a process of transnational and transcultural integration of human and non-human activities (Al-Rodhan and Stoudmann, 2006) where the economic impacts of globalization has included the removal of trade barriers between countries. As a result, countries have taken great pains to access new markets, causing international trade in the world to dramatically increase during the twenty-first century. According to World Bank statistics, the amount of merchandise exports reached 16,576 trillion USD in 2015, compared to only 124,449 billion USD in 1960.

Primarily, globalization has affected the transportation sector in two different aspects. The popularity of the transportation market has played a key role in international trade (Woodburn et al., 2008) and the resulting demand for a greater number of transportation companies. Also, a significant effect of globalization has been the removal of all barriers between countries resulting in people visiting multiple other countries (Koch-Baumgarten, 1998) and incrementally increasing the business volume of airline companies.

Subsequently, competition in the transportation sector and a higher demand for service has also led to higher profit margins (Borenstein and Rose, 1991). Airlines started to take actions to be more competitive in the market, otherwise, making it impossible for these firms to survive. As a result, decreasing costs for these companies started to play a more substantial role in maintaining profitability.

Europe's location makes it a key competitor in the airline sector and plays a significant role in international trade and touristic travels. According to World Bank statistics, in 2015 alone, 653,368,581 passengers used airlines in Europe, surging from just 63,336,700 in 1970. Fig. 1 shows the growth in scheduled airline seats from Europe to other regions, especially over the last 2 years.

In 2015, as a result of the negative effects of high competition in the airline sector, the European Union developed a new aviation strategy (Moores, 2015). The main purpose of this strategy was to increase the competitive advantage of European airline companies in this sector by providing airline companies access to all world destinations. This strategy is expected to contribute to increased economic growth and a decrease in the unemployment rate, resulting in a 5% growth in the European airline industry by 2030.

European airline companies should increase their investment opportunities in order to have a competitive advantage, and in particular, must focus on the two areas of debt or equity. With respect to acquiring debt, the cost to these companies will be the interest rate paid to the banks. As for equity, the cost will be lower, but the companies must be successful in order to attract the attention of the investors. Accordingly, financial analysis has a significant role in order to understand whether these companies' investments are successful (Helfert, 2001).

In addition to financial analysis, non-financial conditions of the companies are also important since financial data provides limited information to the investors. For instance, communication levels within companies give significant information related to the companies, but are impossible to achieve using only financial reports (Chatterji and Levine, 2006). Investors need to give importance to both financial and non-financial data in making investment decisions.

3. Literature review of airline industry

There are multiple studies in the literature related to the airline industry focused on different aspects as detailed on Table 1.

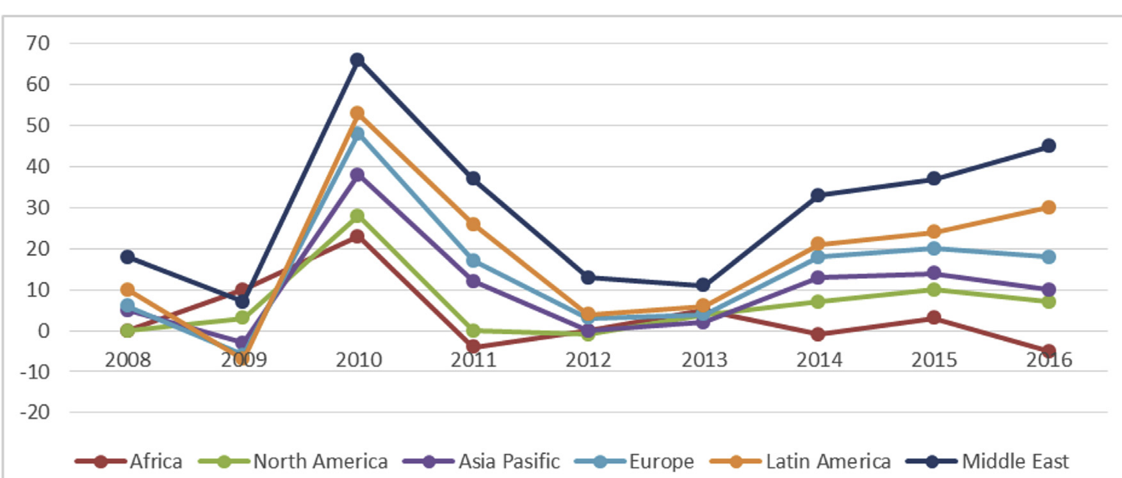

Fig. 1. Growth in scheduled airline seats from Europe to other regions (%).
Source: CAPA

Table 1
Studies related to airline industry.

Author	Scope	Model	Result
Pate and Beaumont (2006)	Europe	Descriptive Statistics	It was concluded that effective human resource management is very significant so as to increase the performance of airline industry.
Adler and Smilowitz (2007)	Europe	Sensitivity Analysis	They showed that all mergers in airline sector are not successful.
Franke and John (2011)	Europe	Descriptive Statistics	Because of the negative aspects experienced in 2001 crisis, European airline companies tried to take immediate actions in 2008 global crisis.
Dobruszkes and Van Hamme (2011)	Europe	Regression	The effects of the financial crisis to airline companies differ according to the constraints they face in adopting their supply to the geography.
Pearce (2012)	Europe	Descriptive Statistics	It was emphasized that return on equity decreased very much after the great recession.
Hsu and Liou (2013)	Taiwan	DEMATEL	They reached a conclusion that employees with good knowledge skills contribute to better service quality
Limpanitgul et al. (2013)	Thailand	Survey	IT was identified that employees' involvement in recommending service improvements increase job satisfaction.
Johnston and Ozment (2013)	US	Regression	It was defined that US airlines have enjoyed increasing returns to scale for the past 22 years.
Lee et al. (2013)	US	Regression	They reached a conclusion that operation related corporate social responsibility activities increase the performance of the firm.
Greenfield (2014)	US	Regression	The effect of competition on airline on-time performance is very important.
Nikookar et al. (2015)	Iran	Survey	They analyzed that satisfaction, loyalty, service quality and trust have a significant impact on word of mouth in airline industry.
Treanor et al. (2014)	US	Regression	They made a conclusion that airlines increase hedging activity because of higher fuel price.
Dursun et al. (2014)	Turkey	Descriptive Statistics	It was concluded that economic stability of Turkey especially after 2003 leads to increase the performance of airline industry.
Zhang et al. (2014)	China	Regression	It was defined that low-cost carriers, income level, population size, seasonality, and number of competing airlines are the main determinants of competition in the Chinese airline market.
Chow (2014)	China	Tobit	It was concluded that on-time performance of scheduled flights has no significant effect on customer complaints.
Babić et al. (2014)	Europe	Fuzzy logic system	They created a market share model for airline industry by considering number of competitors, frequency of flying and membership to specific alliances.
Berghöfer and Lucey (2014)	64 airlines	Regression	Financial hedging does not have significant effect to reduce risk exposure.
Zou et al. (2014)	US	Regression	They concluded that airline fuel consumption is highly correlated with the amount of revenue.
Fritzsche et al. (2014)	Literature Review	Descriptive Statistics	They developed a mathematical model to find the optimal length of the prognostic distance.
Karatepe and Choubtarash (2014)	Turkey	Survey	Training is very significant to improve the knowledge, skills, and abilities of ground staff members in service delivery and complaint-handling processes.
Moon et al. (2015)	46 airlines	Logit	It was determined that firm size and cash holdings affect dividends payments whereas firm size influences share repurchase.
Moreno-Izquierdo et al. (2015)	Europe	Regression	They concluded that consumers should buy their tickets before 25 days prior to departure in order to have minimum price.
Otero and Akhavan-Tabatabaei (2015)	Literature Review	Descriptive Statistics	They proposed a dynamic pricing model to find the pricing policy which maximizes the total revenue of the flight.
Daft and Albers (2015)	Europe	Descriptive Statistics	It was analyzed that similarity between the business models of the airline companies increases over the time.
Schosser and Wittmer (2015)	Europe	Descriptive Statistics	They determined that the mergers of European airline companies have lower synergy whereas integration costs of them are also lower in comparison with American companies.
Mellat-Parast et al. (2015)	US	Regression	It was concluded that customer complaint and arrival delays have an impact on the profitability of airline companies.
Vaaben and Larsen (2015)	Europe	Descriptive Statistics	They made an analysis for European airlines to solve the problem of airspace congestion.
Chow (2015)	China	Regression	It was determined that an increase in actual on-time performance reduces customer complaints.
Chen (2016)	Taiwan	DEMATEL and ANP	Enhancement of customer relationship management is very important to increase service quality for airline companies.
Yan et al. (2016)	40 airline companies	Regression	Technology and process-based environmental innovations positively influence airlines' revenue.
Lee and Moon (2016)	US	Regression	They determined that a CEO's tenure and education play a significant role in accounting for airlines' strategic risk-taking.
Saranga and Nagpal (2016)	India	Data Envelopment Analysis	It was understood that technical efficiency increases market performance for Indian airline companies.
Steven et al. (2016)	US	Regression	It was identified that there is a negative relationship between mergers and service quality in airline industry.
Kuo et al. (2016)	Taiwan	Survey	It was defined that corporate social responsibility has a significant effect on the image of airline companies.

Table 1 shows that most of the studies are related to the performance of airline companies. For instance, Johnston and Ozment (2013) researched the airline industry in the US and used annual data for the periods between 1987 and 2009. As a result of regression analysis, they determined that US airlines have enjoyed increasing returns to scale for the past 22 years. Similar to this study, Dursun et al. (2014) identified that the economic stability of Turkey, especially after 2003, led to growth in the performance of the airline industry. In addition to those studies, Greenfield (2014) tried to evaluate the performance of US airline companies (using regression analysis) and concluded that the size of competition is very important for performance.

Furthermore, there are also some studies which tried to identify the determinants of the performance in the airline industry. Nikookar et al. (2015) analyzed the Iranian airline sector and concluded that customer loyalty and service quality have a significant impact on the performance of airline industry. Parallel to this study, Zhang et al. (2014) determined that income level, population size, seasonality, and the number of competing airlines are the main determinants of competition in the Chinese airline market. Also, Moon et al. (2015) discovered that firm size influences the performance of airline companies; whereas, Saranga and Nagpal (2016) and Yan et al. (2016) maintained that technical efficiency increases market performance.

In evaluating other determinants on the market, customer satisfaction is yet another important factor. Mellat-Parast et al. (2015) looked at the US airline industry and reached the conclusion that both customer complaints and arrival delays have an impact on the profitability of airline companies. In comparison, Chow (2014) focused on customer satisfaction in the Chinese airline industry and showed that on-time performance of scheduled flights had no significant effect on customer complaints. However, by using a different method, Chow (2015) concluded that an increase in actual on-time performance reduced customer complaints. Similar to this study, Chen (2016) determined that customer relationship management is very important to increase service quality for airline companies for the Taiwanese market, whereas, in the European airline sector, Vaaben and Larsen (2015) illustrated that solving the problem of airspace congestion actually increased overall customer satisfaction.

In terms of other effects on the airline industry, specifically the financial crisis, Dobruszkes and Van Hamme (2011) analyzed the negative aspects of the global economic crisis on the European airline industry. As a result of regression analysis, their results showed the effects of the financial crisis differed according to the constraints they faced in adopting their supply to the geography. Similarly, Pearce (2012) also made a study to define the effects of the global mortgage crisis on Europeans airline industry. They concluded that the return on equity of these airline companies decreased after this crisis. Additionally, Franke and John (2011) analyzed the strategies developed by European airline companies to minimize the effects of the global economic crisis of 2008, and they reached the conclusion that those companies are very successful for this issue.

Another underlining factor beyond past crisis is the importance of fuel pricing since it directly affects the profitability of the airline companies. Zou et al. (2014) tried to examine fuel efficiency of US airlines (using regression analysis) and identified airline fuel consumption as being highly correlated to revenue. Because fuel price is essential for the performance of airline industry, other studies focused on ways to hedge the fuel price risk. Within this scope, Berghöfer and Lucey (2014) analyzed 64 different airlines and defined that financial hedging does not have a significant effect on reducing risk exposure. Despite the conclusion of this study, Treanor et al. (2014) argued that airlines increase hedging activity because of higher fuel pricing.

Then to, other studies explored the relationship between the performance of airline companies and corporate social responsibility activities. Lee et al. (2013) looked at the effects of corporate social responsibility activities on the US airline companies. They used annual data for the periods between 1991 and 2009 (with regression analysis) and concluded that operation related corporate social responsibility activities increase the performance of the airline companies. Later, Kuo et al. (2016) made a similar study in the Taiwan airline industry by using a survey analysis. As a result, they identified corporate social responsibility does have an effect on the image of airline companies.

Connected to social responsibility, the importance of qualified human resource management in airline industry has also been shown to be a factor. Pate and Beaumont (2006) established that effective human resource management is very significant in increasing the performance of the European airline industry. Additionally, Hsu and Liou (2013), using different methodology, reached a similar conclusion for the Taiwanese airline sector. Furthermore, Limpanitgul et al. (2013) and Karatepe and Choubtarash (2014) conducted a survey analysis showing employee training is very significant in improving the performance of the airline industry. In addition to those studies, Lee and Moon (2016) analyzed the US airline industry concluding that education also plays an important role in performance.

Additionally, mergers of airline companies have also attracted the attention of many researchers. Adler and Smilowitz (2007) evaluated mergers in the European airline industry, noting that mergers in the airline sector have not been successful. Moreover, Schosser and Wittmer (2015) compared mergers in European and US industries and reached the conclusion that integration costs of European companies are lower in comparison with American companies. In addition to these studies, Steven et al. (2016) analyzed the mergers in the US airline industry (by regression analysis). They pointed to a negative relationship between mergers and service quality.

Finally, study by Babić et al. (2014), related to the airline sector, focused on determining optimum aspects and created an optimum model to increase market share. Fritzsche et al. (2014) also developed a mathematical model to find the optimal length of the prognostic distance. Moreover, Moreno-Izquierdo et al. (2015) and Otero and Akhavan-Tabatabaei (2015) tried to create a model to maximize total revenue; while Daft and Albers (2015) compared the business models of the airline companies over the years.

4. A multidimensional approach to performance measurement in airline industry

Performance measurement is a process which analyzes the outputs of the company and the effectiveness of the resources obtained by this company. In order to achieve this objective, the appropriate data of the company related to this situation should be collected, evaluated, and reported to necessary units. Performance measurement aims to contribute to the improvement of the company's performance by showing the essential areas for the employees to focus on in their work.

Performance evaluation of the companies is crucial for many different parties. Within this scope, each of these parties focuses on different aspects of the company. For example, top management gives greater importance to liquidity and profitability concepts in order to make effective strategic decision. On the other side, investors nowadays consider non-financial conditions, in addition to financial issues, for the performance of companies and creditors.

In the past, companies considered only financial information with respect to the performance measurement. However, they realized that this situation is not efficient because it was limited and modern performance measurement methods were later developed. Within this context, the balanced scorecard approach can be used for multi-dimensional analysis of performance measurement.

The balanced scorecard approach has four different perspectives; financial, customer, internal processes, and learning and growth. Regarding the financial perspective, the ratios in the financial tables of the company are used to evaluate financial performance. On the other side, with respect to the customer perspective, some criteria related to the customers, such as customer satisfaction are taken into consideration. In addition to them, the perspective of internal processes gives information about the steps used inside the company, such as production operations. The final perspective of the balanced scorecard approach is learning and growth which explains the development of the company with respect to the new projects and employee qualifications (Kaplan and Norton, 1996).

After this method was developed, it attracted the attention of many different researchers. Hence, this method was used in various studies, some of which are detailed on Table 2.

For example, Dinçer et al. (2016a,b) evaluated the Turkish banking sector by using the corporate balanced scorecard approach. As a result of the analysis, they concluded that the most important factor for the balanced scorecard approach is the financial aspect. In addition to this study, Yahaya (2009); Wu et al. (2009); Eskandari et al. (2013); Alidade and Ghasemi (2015); Panicker and Seshadri (2013); Shaverdi et al. (2011); Rostami et al. (2015); Al-Najjar and Kalaf (2012); Akkoç and Vatansever (2013) and Abay (2010) also used this method in order to analyze the performance of the banks.

Specifically, Wang et al. (2010) evaluated the performance of research and development departments of companies in Taiwan using the corporate balanced scorecard approach. Similar to this study, Cebeci and Sezerel (2008) also created a performance evaluation model for the same departments of Turkish companies. Similarly, Bigliardi and Ivo Dormio (2010) measured the performance of R&D projects in Italy.

In addition to those studies, Sandström and Toivanen (2002) also used this method for an engineering industry in Finland. On the other side, Yee-Ching (2006) evaluated the performance of hospitals in Canada and Kunz and Schaaf (2011) used this approach for the health sector in Germany. Furthermore, by using the balanced scorecard approach, the performance of the IT sector was taken into consideration by Lee et al. (2008) and Wang and Xia (2009). Additionally, Su et al. (2011) and Bentes et al. (2012) made a performance analysis of the mobile industry in Taiwan and Brazil.

On the other side, balanced scorecard approach is very beneficial to evaluate the companies in airline industry as well. Owing to this situation, this method was used in many different studies related to this industry. As a result of the analysis, factors reviewed in the studies are detailed on Table 3.

As seen in Table 3, in order to evaluate the performance of airline companies, 17 different variables were determined for 4 different perspectives of the balanced scorecard approach. With respect to the customer perspective, there are 3 different variables. The ratio of “profit per customer” gives information about the increase or decrease in the profit amount of the company in comparison with the number of customers (Leung et al., 2006), (Eskandari et al., 2013), (Dinçer et al., 2016a,b). In other words, it explains the profitability of the company according to the number of the customers. Moreover, the ratio of “the number of passengers/number of seats” reflects the success of an airline company in attracting customers (Feng and Wang, 2000), (Lin and Hong, 2006), (Zins, 2001). Additionally, the ratio of “changing in the number of the customers” shows the success of an airline company in increasing customer retention and loyalty (Chen et al., 2011), (Amiran et al., 2011), (Alidade and Ghasemi, 2015).

Regarding financial perspective, 5 different variables can be taken into the consideration. The variable of “return on equity” shows the amount of net profit as a percentage of shareholders equity. That is to say, it gives information about how much a profit a company can make with money invested by the owners (Zhang

Table 2
Studies related to corporate balance scorecard.

Authors	Scope	Method	Result
Sandström and Toivanen (2002)	Finland	Descriptive Statistics	They concluded that balanced scorecard approach is very helpful in order to manage design engineers.
Yee-Ching (2006)	Canada	Analytic Hierarchy Process	AHP process was applied to scorecards of the hospitals in order for performance comparison.
Lee et al. (2008)	Taiwan	Fuzzy Analytic Hierarchy Process	They determined that customer and internal business process have higher priority for IT departments.
Cebeci and Sezerel (2008)	Turkey	Analytic Hierarchy Process	They generated a new model that can evaluate the performance of R&D departments.
Yahaya (2009)	Ghana	Descriptive Statistics	Non-financial factors of BSC are influential so as to evaluate the performance of the banks.
Wang and Xia (2009)	China	Analytic Hierarchy Process	They evaluated a software company by using four major perspectives of BSC
Wu et al. (2009)	Taiwan	Fuzzy Multiple Criteria Decision Making	FAHP model based on BSC approach gives effective results with respect to defining banks' performance.
Abay (2010)	Ethiopia	Regression	Non-financial indicators give important information as for evaluation the performance of the banks.
Bigliardi and Ivo Dormio (2010)	Italy	Delphi Technique	Balanced scorecard approach is suitable to measure the performance of R&D project.
Wang et al. (2010)	Taiwan	Descriptive Statistics	They evaluated the performance of R&D department by using BSC model.
Kunz and Schaaf (2011)	Germany	Analytic Hierarchy Process	Balanced scorecard approach is useful in order to evaluate the performance of health care sector.
Su et al. (2011)	Taiwan	DEMATEL	They determined the indicators of weight value to assess the performance of mobile industry in Taiwan.
Shaverdi et al. (2011)	Iran	Fuzzy Analytic Hierarchy Process	It was identified that customer is the most significant perspective of BSC in order to evaluate the performance of the banks.
Bentes et al. (2012)	Brazil	Analytic Hierarchy Process	They combined BSC and AHP approaches to make more effective performance evaluation in telecommunication sector.
Al-Najjar and Kalaf (2012)	Iraq	Descriptive Statistics	It was concluded that there is an increase in the performance of the large local banks in Iraq.
Eskandari et al. (2013)	Iran	DEMATEL	Significant indicators related to the performance evaluation of the banks were defined.
Akkoç and Vatansever (2013)	Turkey	Fuzzy TOPSIS	They analyzed the performance of 12 Turkish banks by using 17 BSC indicators.
Panicker and Seshadri (2013)	India	Descriptive Statistics	They identified that the performance of Standard Charter Bank in India decreased in the last two years.
Alidade and Ghasemi (2015)	Iran	TOPSIS	They created a model which ranked the branches of Bank Sepah of Sistan and Baluchestan.
Rostami et al. (2015)	Iran	Fuzzy Analytic Hierarchy Process	Regarding balanced scorecard aspects, customer has the first priority for Iranian banking sector.
Dinçer et al. (2016a,b)	Turkey	Analytic Hierarchy Process	Financial factor of balanced scorecard approach has the highest priority in order to evaluate the performance of Turkish banks.

Table 3
Proposed perspectives and key factors of performance measurement for the airline industry.

Perspectives of BSC	Key Factors	References
Customer	Profit per Customer	Sandström and Toivanen (2002); Wu and Liao (2014); Barros and Peypoch (2009)
	The Number of Passengers/Number of Seats	Lin and Hong (2006); Zins (2001); Barros and Dieke (2007)
	Increasing Customer Retention and Loyalty	Rostami et al. (2015); Alidade and Ghasemi (2015)
Finance	ROE	Yahaya (2009); Panicker and Seshadri (2013); Wang (2008)
	ROA	Dave and Dave (2012)
	Growth in Profit	Brulhart et al. (2015); Wang (2008)
	Debt Ratio	Bigliardi and Ivo Dormio (2010); Feng and Wang (2000)
	Current Ratio	Wang (2008)
Internal Process	Flying on Time	Yahaya (2009); Cho and Lee (2011)
	Sales Performance	Wu et al. (2009); Shaverdi et al. (2011)
	Number of Accidents	Lin et al. (2016); Chang and Yeh (2001)
	Flights/Number of Employees	Wang et al. (2004)
	Number of Flights/Number of Fleets	Lin (2008)
	Number of Passengers/Number of Employees	Zins (2001); Barros and Dieke (2007); Wang et al. (2004)
Learning and Growth	Staff Turnover Rate (Number of Employees)	Dave and Dave (2012); Bhadra (2009)
	Increase in Number of Planes	Lee et al. (2008); Cebeci and Sezerel (2008); Bentes et al. (2012)
	Profit per Employee	Noori (2015); Brulhart et al. (2015)

et al., 2014), (Yahaya, 2009), (Wu et al., 2009), (Su et al., 2011). Similar to this variable, the ratio of "return on asset", which is calculated as "net profit/total assets", refers to the efficiency of a company to generate profit by using its assets (Dave and Dave, 2012), (Chen et al., 2011), (Amiran et al., 2011), (Alidade and Ghasemi, 2015). Also, the variable of "growth in profit" shows the success of the company in increasing its profit amount (Bigliardi and Ivo Dormio, 2010), (Amiran et al., 2011), (Akkoç and Vatansever, 2013). Moreover, "debt ratio" is calculated as "total debts/total assets". Therefore, higher debt ratio refers to the situation of higher financial risk (Al-Najjar and Kalaf, 2012), (Feng and Wang, 2000). Furthermore, "current ratio" means the ability of a company to pay its short-term debt by using its current assets. Thus, this ratio shows the liquidity power of a company to pay its short-term obligation (Panicker and Seshadri, 2013), (Alidade and Ghasemi, 2015), (Akkoç and Vatansever, 2013).

As for the internal process perspective of the balanced scorecard, the variable of "flying on time" shows the performance of the airline companies (Zhang et al., 2014), (Yahaya, 2009). Comparably, an increase in net sales gives information about the "sales performance" (Wu et al., 2009), (Shaverdi et al., 2011). Additionally, if "number of accidents" is high, this defines the deficiency in the internal process of airline companies (Lin et al., 2016), (Leung et al., 2006). Moreover, if the ratio of "flights/number of employees" is higher, this explains how airlines can successfully increase the number of the flights by using its current employees (Feng and Wang, 2000), (Chang and Yeh, 2001). Similar to this variable, the numbers of total flights can also be compared with the number of fleets as well (Chang and Yeh, 2001), (Lin, 2008). Additionally, the ratio of "number of passengers/number of employees" identifies the ability of the airline companies to increase their passengers by using their employees (Lin and Hong, 2006), (Zins, 2001), (Barros and Dieke, 2007).

With respect to the learning and growth perspective of balanced scorecard, 3 different variables were weighed. First of all, the difference in the number of employees during a specific time frame gives information about the employee turnover rate. If there is a radical decrease in the number of employees of an airline company, this indicates that employees do not prefer to work in this company. In other words, this situation describes a problem in that country (Rostami et al., 2015), (Panicker and Seshadri, 2013), (Lin et al., 2016), (Leung et al., 2006). In contrast, the variable of "increase in number of planes" refers to the product or service growth for an airline company (Bigliardi and Ivo Dormio, 2010), (Al-Najjar and Kalaf, 2012), (Alidade and Ghasemi, 2015). The final variable of learning and growth perspective is the "profit per employee" which gives information about the ability of an airline company to generate profit as a percentage of its total employees (Leung et al., 2006), (Dinçer et al., 2016a,b), (Dave and Dave, 2012), (Chen et al., 2011), (Brulhart et al., 2015).

5. Methodology

After analyzing similar studies in literature, we recognized that most studies used regression, data envelopment analysis, and survey methods in order to achieve their objectives. We identified the need for an original methodology and have used a combination of three different methods in the analysis process. These three methods will be discussed separately in the following subtitles.

5.1. Fuzzy DEMATEL

Gabus and Fontela developed the DEMATEL (The Decision Making Trial and Evaluation Laboratory) method in the research center in Genova (Wu, 2008). This method divided the factors as cause and effect groups, since it helps to evaluate causality relationships between the variables more effectively (Shieh et al., 2010), (Wu, 2008), (Tseng, 2009). In addition to this condition, the fuzzy DEMATEL method was developed in order to analyze complex problems (Tseng and Lin, 2009). The details of the procedures in fuzzy DEMATEL methods are given below.

Step 1: First of all, the decision goal is determined in order to solve the problem.

Step 2: Evaluation criteria is developed and a fuzzy linguistic scale is designed. The main reason for developing criteria is to understand the causal relationship. Additionally, designing a fuzzy linguistic scale will contribute to solving the problems of uncertainty in human assessment process. The degree of this scale consists of five different aspects, such as "No", "Low", "Medium", "High", "Very High".

Step 3: The evaluation of the decision makers is provided. Within this scope, a group of "p" expert makes a comparison of these criteria by using these five different aspects so as to understand the relationship. After that, it is possible to obtain p fuzzy matrices ($\check{Z}1$, $\check{Z}2$, …, $\check{Z}p$) that represent the views of p different experts. Moreover, an average fuzzy matrix $\check{Z}$ can be calculated by using the following equation.

$$\check{Z} = \frac{\check{Z}^1 \oplus \check{Z}^2 \oplus \ldots \oplus \check{Z}^p}{p} \quad (1)$$

This matrix can also be shown as the following:

$$\check{Z} = \begin{bmatrix} 0 & \cdots & \check{Z}_{1n} \\ \vdots & \ddots & \vdots \\ \check{Z}_{n1} & \cdots & 0 \end{bmatrix}$$

In this matrix, Žij shows triangular fuzzy numbers. Thus, it can be shown as Žij = (lij, mij, uij).

Step 4: The normalized direct relation fuzzy matrix is developed and the details of this matrix are given below.

$$\overline{X} = \begin{bmatrix} \overline{X}_{11} & \cdots & \overline{X}_{1n} \\ \vdots & \ddots & \vdots \\ \overline{X}_{n1} & \cdots & \overline{X}_{nn} \end{bmatrix}$$

In this matrix, the following equations should be taken into the consideration:

$$\overline{X}_{ij} = \frac{\check{Z}_{ij}}{r}\left(\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{u_{ij}}{r}\right) \quad (2)$$

$$r = max_{1 \le i \le n}\left(\sum_{j=i}^{n} u_{ij}\right) \quad (3)$$

The main assumption of Equation (3) is that there is at least one “i” which satisfies the condition of $\sum_{j=i}^{n} u_{ij} < r$.

Step 5: Total relation fuzzy matrix is obtained. When Xij = (l'ij, m'ij, u'ij), three different crisp matrix can be identified as the following:

$$X_l = \begin{bmatrix} 0 & \cdots & l'_{1n} \\ \vdots & \ddots & \vdots \\ l'_{n1} & \cdots & 0 \end{bmatrix} \qquad X_m = \begin{bmatrix} 0 & \cdots & m'_{1n} \\ \vdots & \ddots & \vdots \\ m'_{n1} & \cdots & 0 \end{bmatrix} \qquad X_u = \begin{bmatrix} 0 & \cdots & u'_{1n} \\ \vdots & \ddots & \vdots \\ u'_{n1} & \cdots & 0 \end{bmatrix}$$

Total relation fuzzy matrix can be defined as $\check{T} = \lim_{k \to \infty}(\overline{X} + \overline{X}^2 + \ldots + \overline{X}^k)$. Moreover, it can be illustrated in the following matrix.$\check{T} = \begin{bmatrix} \breve{t}_{11} & \cdots & \breve{t}_{1n} \\ \vdots & \ddots & \vdots \\ \breve{t}_{n1} & \cdots & \breve{t}_{nn} \end{bmatrix}$ where $t_{ij} = (l''_{ij}, m''_{ij}, u''_{ij})$

and

$$l''_{ij} = X_l \times (1 - X_l)^{-1} \quad (4)$$

$$m''_{ij} = X_m \times (1 - X_m)^{-1} \quad (5)$$

$$u''_{ij} = X_u \times (1 - X_u)^{-1} \quad (6)$$

Step 6: $(\breve{D}_i + \breve{R}_i)^{def}$ and $(\breve{D}_i - \breve{R}_i)^{def}$ values are obtained. Within this scope, each triangular fuzzy numbers of total-relation fuzzy matrix are defuzzied. This new matrix is shown below:$\check{T}^{def} = \begin{bmatrix} \breve{t}^{def}_{11} & \cdots & \breve{t}^{def}_{1n} \\ \vdots & \ddots & \vdots \\ \breve{t}^{def}_{n1} & \cdots & \breve{t}^{def}_{nn} \end{bmatrix}$ where $t^{def}_{ij} = (l''_{ij}, m''_{ij}, u''_{ij})^{def}$

In this analysis, $\breve{D}^{def}_i$ is the sum of the matrix $\breve{T}^{def}$ whereas $\breve{R}^{def}_i$ refers to the sum of the columns. Fuzzy DEMATEL method was used in many different studies in the literature. Büyüközkan and Çifçi (2012), Hsu et al. (2013), Mavi et al. (2013) and Lin (2013) evaluated green suppliers in their study. In addition to these studies, Abdullah and Zulkifli (2015), Chou et al. (2012) and Wu and Lee (2007) evaluated the performance of human resource management departments within the companies. Furthermore, Jafari-Eskandari et al. (2013) made a study to analyze the performance of the banks by using the fuzzy DEMATEL method. Moreover, Nikjoo and Saeedpoor (2014) tried to evaluate the performance of the insurance sector in Iran with the help of this method. Moreover, Mashtani (2012) used the fuzzy DEMATEL method to improve the performance of the universities.

5.2. Fuzzy ANP

Analytic Network Process (ANP) is another method which helps to make decisions in a complex situation. Saaty and Vargas (1998) developed this method as a general form of analytic hierarchy process. In ANP, firstly, the purpose is defined and clusters are identified according to this purpose. After that, a supermatrix is developed as a different combination of the elements in these clusters. Next, a weighted matrix of this supermatrix is created. Finally, the best alternative is selected so as to reach the purpose (Dinçer et al., 2016a,b). However, ANP may have some -problems in order to reflect the real values of the elements. To overcome this problem, fuzzy ANP method is preferred because it gives more effective results in comparison with ANP (Uygun et al. (2015). While using the extent analysis of Chang (1996), the steps of the fuzzy ANP were detailed below.

Step 1: Fuzzy synthetic extent value is determined.

$$S_i = \sum_{j}^{m} M^j_{g_i} \otimes \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{g_i}\right]^{-1} \quad (7)$$

In equation (7), G = {g₁, g₂, …, gm} represents the goal set of the object set of X = {x₁, x₂, …, xn}. Additionally, $M^j_{g_i}$ refers to the triangular fuzzy numbers where j = 1, 2, …, m. Therefore, it can be said that there are m extent analysis values. On the other side, $\sum_{j=1}^{m} M^j_{g_i}$ can be provided by making fuzzy addition operation such as:

$$\sum_{j=1}^{m} M^j_{g_i} = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j\right) \quad (8)$$

In addition to this situation, the value of $[\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{g_i}]^{-1}$ can be obtaines by using following equations.

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{g_i} = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i\right) \quad (9)$$

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M^j_{g_i}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} l_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} u_i}\right) \quad (10)$$

Step 2: The degree of the possibility of $M_2 = (l_2, m_2, u_2) \ge M_1 = (l_1, m_1, u_1)$ can be defined as equation (11).

$$V(M_2 \ge M_1) = hgt(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1, & if\ m_2 \ge m_1 \\ 0, & if\ l_1 \ge u_2 \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & otherwise \end{cases} \quad (11)$$

As it can be understood from equation (11), “d” represents the intersection point of μ_{M_1} and μ_{M_2}.

Step 3: The degree of the possibility for a convex fuzzy number greater than k convex fuzzy numbers is defines. Within this context, "M" refers to the convex fuzzy number whereas M_i (i = 1, 2, …, k) shows the k convex fuzzy numbers. This possibility can be shown on equation (12).

$$V(M \geq M_1,\ M_2,\ \ldots,\ M_k) = min\ V(M \geq M_i),\ i = 1,2,\ldots,k \tag{12}$$

In addition to this condition, we assume the following equation.

$$d^{'}(A_i) = \min V\ (S_i \geq S_k)\ where\ k \neq i \tag{13}$$

As a result, the weight factor can be calculated on equation (14).

$$W^{'} = (d\prime(A_1),\ d\prime(A_2),\ldots,\ d\prime(A_n))^T \quad where\ \ A_i(i = 1,2,\ldots n) \tag{14}$$

Step 4: Normalization process is performed. In this process, normalized weight vectors can be defined as equation (15).

$$W = (d(A_1),\ d(A_2),\ldots,\ d(A_n))^T \tag{15}$$

Fuzzy ANP attracted the attention of many researchers, so there are lots of studies in the literature in which this method was used. Mohanty et al. (2005), Mohaghar et al. (2012) and Seyedhosseini and Ghoreyshi (2011) made an analysis in order to determine the best R&D project by using fuzzy ANP method. Moreover, Kang et al. (2012), Yücenur et al. (2011), Dargi et al. (2014); Göztepe and Boran (2012) and Pang (2009) used this method so as to choose the best supplier. In addition to these studies, the fuzzy ANP method is also popular in performance evaluation process. Within this context, Wu et al. (2008) evaluated the medical organizational performance, Dinçer et al. (2016a,b) made a performance analysis of Turkish banking sector and Chen et al. (2015) evaluated the performance of the touch panel industry in Taiwan.

5.3. MOORA

Brauers and Zavadskas (2006) developed the Multi-Objective Optimization on the basis of the Ratio Analysis (MOORA) method. Complex alternatives are analyzed in this method while considering some limitations. In the analysis process of MOORA method, the following steps will be taken into consideration (Zavadskas et al., 2015), (Brauers et al., 2008).

Step 1: Decision matrix should be created. Different alternatives are stated in this matrix. The details of this matrix were illustrated in equation (16).

$$X_{ij} = \begin{bmatrix} X_{11} & \cdots & X_{1n} \\ \vdots & \ddots & \vdots \\ X_{m1} & \cdots & X_{mn} \end{bmatrix} \tag{16}$$

In equation (16), X_{ij} shows value of the alternative j for the criterion i. On the other side, m refers to the number of alternatives whereas n gives information about the criteria.

Step 2: Normalization of the fuzzy matrix is made and this normalization process is performed by using vector normalization. In this process, the following equation is considered.

$$X_{ij}^{*} = \frac{X_{ij}}{\sqrt{\sum_{j=1}^{m} X_{ij}{}^{2}}} \tag{17}$$

In equation (17), the denominator gives information about the all alternatives. On the other hand, X_{ij} means the normalized performance for alternative j and criteria i. As a result, it can be said that equation (17) always takes values between 0 and 1 (Dinçer, 2015).

Step 3: Positive and negative effects of the normalized performance are evaluated. Within this scope, if a criterion increases the performance, then it should take positive value in case of the maximization. On the other side, the criteria, which reduce the performance, will take negative values. Thus, the formula of this situation was demonstrated as the following (Baležentis and Zeng, 2013).

$$Y_i = \sum_{j=1}^{h} X_{ij}^{*} - \sum_{j=h+1}^{n} X_{ij}^{*} \tag{18}$$

In equation (18), h represents the number of maximized criteria. On the other hand, the number of minimized criteria is shown as (n-h).

Step 4: Weighted result of the ranking alternatives is calculated. Within this context, the criteria are multiplied with the weights. The main reason behind this situation is that it will be possible to identify the importance of each criterion. This condition is demonstrated on equation (19) (Mardani et al., 2015a,b).

$$Y_i^{*} = \sum_{j=1}^{h} W_j X_{ij}^{*} - \sum_{j=h+1}^{n} W_j X_{ij}^{*} \tag{19}$$

As it can be understood from equation (19), W_j refers to the weights of the criteria.

Step 5: Alternatives are ranked. In other words, they are listed according to their performance results. Therefore, it is possible to compare the performances of all alternatives.

There are also many studies in the literature in which the MOORA method was used. Dey et al. (2012) and Mandal and Sarkar (2012) performed analysis in order to select the best strategy by using this method. Additionally, Karande and Chakraborty (2012), Pérez-Domínguez et al. (2015) and Matawale et al. (2016) used the MOORA method for supplier selection. Moreover, Dinçer et al. (2016a,b) and Şişman and Dogan (2016) evaluated the performance of the banking sector with the help of this method. Similar to those studies, Görener et al. (2016) selected bank branch locations by using MOORA method.

Furthermore, Brauers and Zavadskas (2009) considered MOORA methodology in order to perform testing for the facilities sector. Also, Ginevičius et al. (2010) analyzed inequalities between the regional incomes in Lithuania with the help of this method. Additionally, Kracka et al. (2015) ranked heating losses in a building, Brauers et al. (2006) evaluated redevelopment alternatives of the buildings, Kalibatas et al. (2012) tried to choose the optimal indoor environment, and Kracka and Zavadskas (2013) aimed to select the most effective refurbishment element by using this method.

In addition, El-Santawy and El-Dean (2012) used this methodology in order to select the best consulting firm. Moreover, Yazdani et al. (2016) applied the MOORA method in their study so as to assess material selection process. Also, Lazauskas et al. (2015a) assessed completion of unfinished residential buildings by using the MOORA methodology. Stanujkic et al. (2015) applied MULTI-MOORA approach for comminution circuits design selection. Lazauskas et al. (2015b) tried to rank the development of sustainable constructions with the help of the MOORA methodology. Similar to this study, Zavadskas et al. (2013) aimed to select effective technological systems in construction by using this method.

6. An application on the European airline industry

6.1. Model construction

An integrated model of the European Airline Industry has been applied for the multi-criteria decision-making process using fuzzy

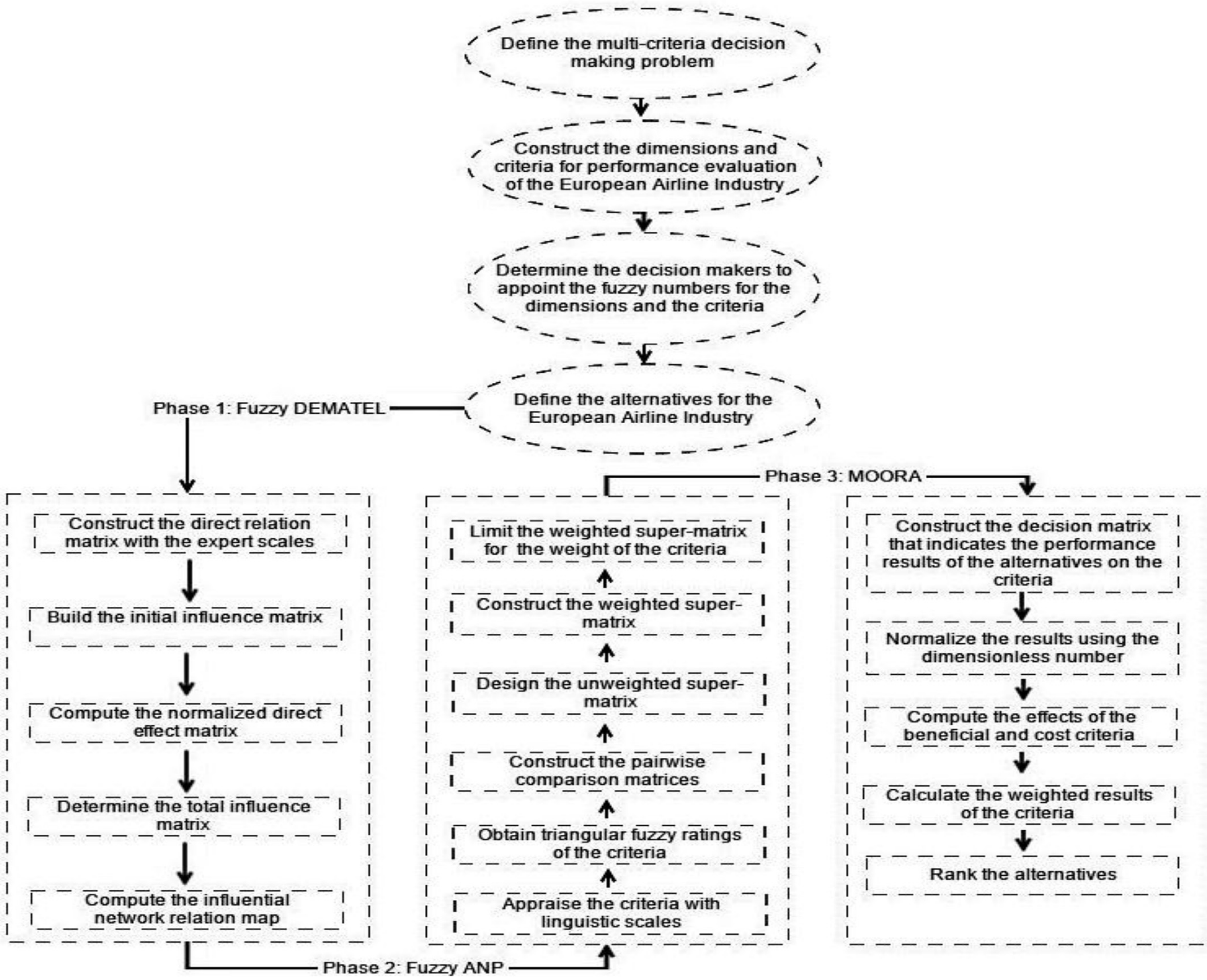

Fig. 2. The flowchart of the integrated multi-criteria decision making approach.

DEMATEL, fuzzy ANP, and MOORA methods respectively. Fig. 2 illustrates the flowchart of the proposed model in detail.

6.2. Analysis results

The integrated model and its implementation could be represented as follows:

Phase 1: The integrated analysis begins by computing the influence degrees of the balance scorecard-based performance dimensions in the European airline industry. For this purpose, the linguistic values that represent the several degrees of influence are used for constructing the direct relation matrix. Table 4 shows the linguistic terms and values of influence degrees for the balanced scorecard (BSC) dimensions or perspectives.

Table 4
Triangular fuzzy numbers of influence degrees.

Influence Scales	Fuzzy Numbers
No influence (N)	(0, 0, 0.25)
Low influence (L)	(0, 0.25, 0.50)
Medium influence (M)	(0,25, 0,50, 0,75)
High influence (H)	(0.50, 0,75, 1,00)
Very high influence (VH)	(0,75, 1,00, 1,00)

Source: Uygun et al., 2015.

The values obtained from three decision makers that have at least five-year experience in the field of finance and transportation are employed in the first step of the analysis. Decision makers' average values are considered to build initial direct relation fuzzy matrix by formula (1). The average values of the fuzzy matrix could be seen in Table 5.

In the following step, the direct relation matrix has been normalized with equations (2) and (3). Table 6 represents the normalized initial direct relation fuzzy matrix.

In the third step, the total influence matrix has been provided by defining three crisp matrices using formulas (4)–(6). Table 7 illustrates the total-relation fuzzy matrix.

Step 4 is interested in the defuzzification process called as converting fuzzy data into crisp scores (CFCS method) and the results could be seen in Table 8.

Table 8 illustrates the deffuzzified values of the balanced scorecard perceptive, and furthermore it provides the cause or effect degrees of the perceptive between each other and their relative

Table 5
The initial direct-relation fuzzy matrix.

Dimensions (Perspectives)	D1			D2			D3			D4		
D1	0.000	0.000	0.000	0.583	0.833	1.000	0.500	0.750	0.917	0.667	0.917	1.000
D2	0.667	0.917	1.000	0.000	0.000	0.000	0.417	0.667	0.917	0.333	0.583	0.833
D3	0.083	0.333	0.583	0.667	0.917	1.000	0.000	0.000	0.000	0.333	0.583	0.833
D4	0.333	0.583	0.833	0.750	1.000	1.000	0.250	0.500	0.750	0.000	0.000	0.000

Table 6
The normalized direct-relation fuzzy matrix.

Dimensions (Perspectives)	D1			D2			D3			D4		
D1	0.000	0.000	0.000	0.200	0.286	0.343	0.171	0.257	0.314	0.229	0.314	0.343
D2	0.229	0.314	0.343	0.000	0.000	0.000	0.143	0.229	0.314	0.114	0.200	0.286
D3	0.029	0.114	0.200	0.229	0.314	0.343	0.000	0.000	0.000	0.114	0.200	0.286
D4	0.114	0.200	0.286	0.257	0.343	0.343	0.086	0.171	0.257	0.000	0.000	0.000

Table 7
The total-relation fuzzy matrix.

Dimensions (Perspectives)	D1			D2			D3			D4		
D1	0.132	0.563	2.484	0.375	0.976	3.165	0.276	0.769	2.838	0.333	0.840	2.910
D2	0.302	0.749	2.634	0.174	0.677	2.786	0.239	0.697	2.728	0.230	0.710	2.764
D3	0.126	0.546	2.312	0.322	0.821	2.764	0.084	0.435	2.240	0.189	0.623	2.508
D4	0.218	0.663	2.493	0.372	0.911	2.913	0.186	0.639	2.580	0.114	0.518	2.424

Table 8
Defuzzified total-relation matrix.

Dimensions (Perspectives)	D1	D2	D3	D4	$\tilde{D}_i^{def}$	$\tilde{R}_i^{def}$	$\tilde{D}_i^{def}+\tilde{R}_i^{def}$	$\tilde{D}_i^{def}-\tilde{R}_i^{def}$
D1	0.88	1.29	1.10	1.16	4.43	3.71	8.15	0.72
D2	1.04	1.00	1.01	1.03	4.09	4.60	8.69	−0.51
D3	0.83	1.11	0.74	0.92	3.60	3.80	7.40	−0.20
D4	0.96	1.20	0.95	0.83	3.94	3.95	7.89	−0.01

weights in the dimension group. The values of $(\tilde{D}_i+\tilde{R}_i)^{def}$ imply the relative importance degrees of the dimensions while the values of $(\tilde{D}_i-\tilde{R}_i)^{def}$ figure out the directions and the degrees of the interrelation among the dimensions.

Table 8 demonstrates that Customer (D2) has the greatest importance with 8.69 as Learning and Growth (D3) has the lowest weight in the dimension group with 7.40. However, Finance (D1) is the best dimension in the effective perspectives whereas Customer (D2) is the most influenced perspective among the dimensions. This explains that European airline companies, which are successful regarding customer dimension, have a higher performance. On the other side, it was defined that variables related to the learning and growth have lower influences on the performance of European airline companies. The cause and effect relationship among the perspectives has been employed by considering the threshold value of average defuzzified total-relation matrix. So, the greater values of the matrix than the threshold one define the effects of the related perceptive. The threshold value has been identified as 1.00 by computing the average value of the matrix. As seen in Table 8, bold values define the effects of the dimensions on the others.

Fig. 3 shows the interrelations among the dimensions. According to the bold values that are greater than the threshold values in Table 8, the directions of the effect have been determined in Fig. 3. The results demonstrate that the dimensions of Finance (D1) and Customer (D2) have absolute impacts on the other dimensions. However, Learning and Growth (D3) has no impact on the other perspectives of balanced scorecard while the perceptive of internal process only impacts customer dimensions.

Phase 2: The following stage continues by computing the importance of the criteria. In first step, linguistic variables and their fuzzy scales have been defined in Table 9.

Table 9 has been used to construct the fuzzy scale of the pairwise comparison matrices. By considering the effect-relation map of the dimensions as seen in Fig. 3, Chang's extent analysis method has been applied to determine the weights of each criterion. The

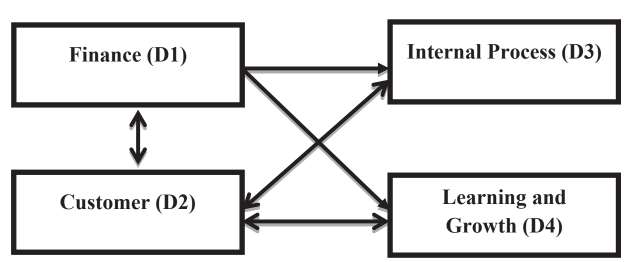

Fig. 3. The impact-relationship of balanced scorecard perspectives using fuzzy DEMATEL (Kaplan and Norton, 1992).

Table 9
The linguistic and fuzzy scales for the criteria weights.

Definition	Triangular Fuzzy Numbers		
Equally important (EI)	0.5	1	1.5
Weakly more important (WI)	1	1.5	2
Strongly more important (SI)	1.5	2	2.5
Very strongly more important (VI)	2	2.5	3
Absolutely more important (AI)	2.5	3	3.5

Source: Chang, 1996; Lee, 2010; Bozbura et al., 2007

Table 10
The evaluations and the local weights for the criteria of D2 in terms of C1.

Criteria (Key factors)	C6			C7			C8			Weights
C6	1.00	1.00	1.00	0.83	1.33	1.83	0.67	1.17	1.67	0.36
C7	0.56	0.78	1.33	1.00	1.00	1.00	1.00	1.50	2.00	0.36
C8	0.61	0.89	1.67	0.50	0.67	1.00	1.00	1.00	1.00	0.27

triangular fuzzy evaluations of the criteria, (in terms of each creation) have been provided by the decision makers and their results have been employed with equations 7–15 to compute the unweighted supermatrix. Table 10 gives an example of the average evaluations for the criteria of Customer (D2) in terms of ROE (C1).

The unweighted supermatrix has been constructed using the local weights of the criteria according to the dimension relationship in Appendix A. In the following step, the unweighted supermatrix has been normalized to construct the weighted supermatrix, and the results are seen in Appendix B. The limit supermatrix has been built by multiplying with itself until each column is equal and stabilized. The weights of the criteria could be determined using the values of each line in Appendix C. The results of the limit supermatrix demonstrate that profit per customer (C6) is the most important key factor while current ratio (C5) is the weakest factor in the balanced scorecard perspectives. This identifies that customer profitability is the most significant indicator of the performance of European airline companies. In contrast, current ratio is accepted as the least important signal regarding the performance of these companies.

Phase 3: The final stage of the integrated model is to implement the decision matrix containing the performance results of each alternative on the criteria and to evaluate the alternative airline companies in Europe. Initially, airline companies in Europe have been determined to select the best firm. For this purpose, 9 companies and 17 balance scorecard-based criteria have been appointed for ranking the alternatives. Table 11 shows the performance results of the companies on each criterion by the end of 2015.

Table 11 shows that A7 has the highest value regarding the criteria of return on equity and return on asset. On the contrary, A2 is the company that has the lowest values for these criteria. Moreover, A7 is the most successful company for the value of profit per passenger and A9 is the best company with respect to the flying on time. Regarding sales performance, A2 and A3 are the most successful firms. On the other hand, A1 and A7 are the companies which only had accidents. As for product/service growth, A3 and A1 are the best companies.

The following steps of the final stage continue by using MOORA method to rank the alternative companies. Table 11 also indicates the decision matrix including the performance results of each alternative. The decision matrix has been constructed by equation (16). And then, the dimensionless number for the alternative companies has been calculated with formula (17). Table 12 illustrates the dimension number for the alternative companies.

Benefit and cost criteria and weighted values have been calculated with equations (18) and (19). Table 13 represents the weighted results have been used for ordering airline companies via MOORA method.

The integrated multicriteria decision-making approach has been completed by calculating the weighted values and ranking the alternatives. The benefit and cost criteria have been weighted using the values obtained from the fuzzy ANP method. In the final step, weighted scores have been listed in descending order. According to the results, A4 has the best company in the European airline industry as A8 is the worst airline company.

While comparing the information in Tables 11 and 13, it can be said that the best company has the highest values of “flights/number of employees”, “number of passengers/number of employees” and “profit per employee” in comparison with other companies. In other words, the company, which works efficiently and effectively, is chosen as the best company according to the results of the analysis. Furthermore, this company is also successful with respect to profitability, liquidity power and customer loyalty.

6.3. Sensitivity analysis

Additionally, the criteria of the hybrid fuzzy-based multicriteria decision-making model could be tested with sensitivity analysis. Sensitivity analysis is defined as the effect of any changes in the criteria on the outcome (Önüt et al., 2009). Therefore, it can be said

Table 11
Balance scorecard-based performance results of selected airline companies.

Perspectives (Dimensions)	Key Factors (Criteria)	A1	A2	A3	A4	A5	A6	A7	A8	A9
Finance	ROE	0.21	0.00	0.08	0.21	0.22	0.29	0.55	0.47	0.14
	ROA	0.06	0.00	0.03	0.07	0.11	0.05	0.16	0.01	0.01
	Growth in Profit (%)	0.65	0.00	0.00	0.91	0.22	29.87	2.57	1.59	0.00
	Debt Ratio (Debt/Total Asset) (%)	0.70	0.89	0.65	0.67	0.54	0.82	0.70	0.99	0.95
	Liquidity Ratio (Current Ratio)	0.81	0.75	1.85	1.72	0.72	0.96	0.60	0.63	0.58
Customer	Profit(USD) per Passenger	17.45	0.00	15.02	10.27	6.21	17.68	47.28	1.10	1.47
	The Number of Customers (Passengers)/Number of Seats	1039.89	795.67	2073.70	1493.18	1435.09	949.55	768.60	2093.09	759.41
	Increasing Customer Retention and Loyalty (Increase in the number of Passengers (%)	0.12	0.14	0.13	0.11	0.06	0.02	0.04	0.16	0.03
Internal Process	Flying on Time (%)	0.87	0.85	0.66	0.80	0.78	0.85	0.80	0.81	0.92
	Sales Performance (Growth in Sales) (%)	0.19	0.30	0.13	0.12	0.04	0.07	0.03	0.05	0.03
	Number of Accidents	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	Flights/Number of Employees	20.56	11.75	30.64	62.17	30.58	8.32	16.54	6.38	7.90
	Number of flights/number of fleets	1514.99	1526.75	2271.84	1896.10	1202.33	1672.77	2465.12	2620.93	1283.92
	Number of passengers/Number of Employees	2780.22	1157.77	4497.68	9645.48	6789.39	892.48	974.80	962.49	883.10
Learning & Growth	Staff Turnover Rate (Number of Employees) (%)	0.11	0.06	0.38	0.04	0.07	0.02	0.01	0.00	0.00
	Product/service growth (Increase in Number of Planes)(%)	0.15	0.00	0.22	0.04	0.07	0.00	0.02	0.00	0.05
	Profit per Employee (USD)	48,524.74	0.00	67,564.25	99,105.72	42,151.20	15,775.02	46,091.59	1058.72	1298.60

Table 12
Dimension number for the companies.

Perspectives (Dimensions)	Key Factors (Criteria)	A1	A2	A3	A4	A5	A6	A7	A8	A9
Finance	ROE	0.24	0.00	0.09	0.25	0.25	0.33	0.62	0.53	0.16
	ROA	0.28	0.00	0.12	0.31	0.49	0.23	0.72	0.02	0.03
	Growth in Profit (%)	0.02	0.00	0.00	0.03	0.01	0.99	0.09	0.05	0.00
	Debt Ratio (Debt/Total Asset) (%)	0.30	0.38	0.28	0.29	0.23	0.35	0.30	0.42	0.41
	Liquidity Ratio (Current Ratio)	0.26	0.24	0.58	0.54	0.23	0.30	0.19	0.20	0.18
Customer	Profit(USD) per Passenger	0.31	0.00	0.26	0.18	0.11	0.31	0.83	0.02	0.03
	The Number of Customers (Passengers)/Number of Seats	0.25	0.19	0.51	0.36	0.35	0.23	0.19	0.51	0.19
	Increasing Customer Retention and Loyalty (Increase in the number of Passengers (%)	0.39	0.44	0.43	0.36	0.19	0.05	0.13	0.52	0.10
Internal Process	Flying on Time (%)	0.35	0.35	0.27	0.33	0.32	0.35	0.33	0.33	0.37
	Sales Performance (Growth in Sales) (%)	0.46	0.73	0.32	0.30	0.09	0.17	0.08	0.11	0.07
	Number of Accidents	0.71	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00
	Flights/Number of Employees	0.25	0.14	0.37	0.76	0.37	0.10	0.20	0.08	0.10
	Number of flights/number of fleets	0.27	0.27	0.40	0.33	0.21	0.29	0.43	0.46	0.23
	Number of passengers/Number of Employees	0.21	0.09	0.34	0.74	0.52	0.07	0.07	0.07	0.07
Learning & Growth	Staff Turnover Rate (Number of Employees) (%)	0.27	0.14	0.93	0.11	0.16	0.04	0.02	0.00	0.00
	Product/service growth (Increase in Number of Planes) (%)	0.52	0.01	0.79	0.13	0.24	0.00	0.06	0.00	0.17
	Profit per Employee (USD)	0.34	0.00	0.47	0.69	0.29	0.11	0.32	0.01	0.01

that sensitivity analysis is used in order to correct the model, and the sensitivity analysis provides a further insight to determine the effectiveness of the model generated (Prakash and Barua, 2016; Kuo, 2011). Accordingly, the soundness of the expert choices is determined by changing the experts' preferences that could affect the ordering of the balance scorecard-based multidimentional performance. For this purpose, the weighted scenario for each case that defines the combination of sensitivity analysis has been computed for the selected European airlines.

Table 14 illustrates the results of each case according to the changed weights in sensitivity analysis by the positive and negative effects of the normalized performance evaluation. Case 1 presents the main results of the proposed model with the weights obtained from the decision makers as seen in Table 13. The first and other cases have been computed by the differentiated weights in Table 14.

Table 15 shows the ranking results for each case. According to the results of the sensitivity analysis, A4 is defined as the best airline company in the multidimensional performance evaluation based on balanced scorecard except for the Cases 8 and 11 while A9 is the worst airline for the most cases. Consequently, the results of the integrated fuzzy-based method with the sensitivity analysis verify the robustness of the proposed hybrid model.

Table 13
Weighted values and ranking alternatives.

Alternatives (Airline companies)	Benefit Criteria	Cost Criteria	Y_i^*	Ranking
A1	0.262	0.075	0.1866	5
A2	0.125	0.023	0.1022	8
A3	0.333	0.107	0.2256	2
A4	0.302	0.018	0.2841	1
A5	0.210	0.023	0.1873	4
A6	0.166	0.012	0.1538	7
A7	0.266	0.048	0.2179	3
A8	0.172	0.009	0.1634	6
A9	0.099	0.009	0.0907	9

Table 14
The results of sensitivity analysis by the positive and negative effects.

Alternatives (Airline companies)	A1	A2	A3	A4	A5	A6	A7	A8	A9
Case 1	0.1866	0.1022	0.2256	0.2841	0.1873	0.1538	0.2179	0.1634	0.0907
Case 2	0.2529	0.1647	0.3199	0.3273	0.2236	0.1516	0.181	0.2002	0.1125
Case 3	0.1845	0.1743	0.2245	0.2841	0.1718	0.1324	0.1336	0.1623	0.0864
Case 4	0.1198	0.141	0.1638	0.234	0.1512	0.1269	0.0806	0.1025	0.085
Case 5	0.1008	0.1363	0.1646	0.221	0.1218	0.1048	0.0626	0.0873	0.0555
Case 6	0.0867	0.0754	0.2067	0.2723	0.1807	0.1388	0.1217	0.1534	0.0767
Case 7	0.1754	0.0799	0.1754	0.3382	0.2405	0.1604	0.2718	0.1502	0.0761
Case 8	0.1503	0.0703	0.1339	0.2415	0.1898	0.2535	0.2328	0.1556	0.078
Case 9	0.109	0.0008	0.0961	0.2141	0.1591	0.1451	0.1385	0.0421	0.0096
Case 10	0.1104	0.0235	0.1182	0.1991	0.1154	0.1511	0.12	0.0449	0.0299
Case 11	0.1883	0.0372	0.2647	0.2274	0.1414	0.1597	0.2101	0.0629	0.0417
Case 12	0.1726	0.0641	0.2439	0.2794	0.1809	0.1533	0.2375	0.1281	0.0538
Case 13	0.1735	0.116	0.2165	0.2281	0.1614	0.1773	0.2102	0.1811	0.0686
Case 14	0.1636	0.1142	0.1821	0.2062	0.1608	0.1736	0.1898	0.1674	0.08
Case 15	0.204	0.182	0.2069	0.2408	0.1653	0.1886	0.1885	0.1884	0.0858
Case 16	0.1114	0.1357	0.1757	0.2256	0.1705	0.1832	0.1612	0.1402	0.0701
Case 17	0.1339	0.1236	0.2051	0.289	0.1977	0.2465	0.1837	0.1328	0.0718

Table 15
Ranking airline companies by cases.

Alternatives (Airline companies)	A1	A2	A3	A4	A5	A6	A7	A8	A9
Case 1	5	8	2	1	4	7	3	6	9
Case 2	3	7	2	1	4	8	6	5	9
Case 3	3	4	2	1	5	7	6	8	9
Case 4	6	4	2	1	3	5	9	7	8
Case 5	6	3	2	1	4	5	8	7	9
Case 6	7	9	2	1	3	5	6	4	8
Case 7	5	8	4	1	3	6	2	7	9
Case 8	6	9	7	2	4	1	3	5	8
Case 9	5	9	6	1	2	3	4	7	8
Case 10	6	9	4	1	5	2	3	7	8
Case 11	4	9	1	2	6	5	3	7	8
Case 12	5	8	2	1	4	6	3	7	9
Case 13	6	8	2	1	7	5	3	4	9
Case 14	6	8	3	1	7	4	2	5	9
Case 15	3	7	2	1	8	4	5	6	9
Case 16	8	7	3	1	4	2	5	6	9
Case 17	6	8	3	1	4	2	5	7	9

7. Discussions and conclusions

Europe has a significant role in the airline transportation sector, mainly due to its proximity to many different continents. As a result, European airlines are very important in several aspects, especially in international trade and tourism. And, as the popularity of the European airline industry increases, investment within the industry will increase, and resulting competition will rise in this market.

On the other hand, high competition in the airline transportation sector has led to reduced profits for the European airline companies. Because of this, the European Union developed an aviation strategy in 2015. The main purpose of this strategy was to increase the competitive power of the European airline companies. Within this scope, they defined strategic issues in order to significantly improve the aviation sector. As an example, they emphasized the importance of technological development so as to achieve this objective.

Therefore, measuring the performance of the airline companies is essential. However, choosing an appropriate performance measurement method is as significant as measuring the performance. By considering only financial aspects, it is impossible to evaluate the performance effectively; therefore, some non-financial aspects should be taken into consideration in performance measurement process.

Within this context, the aim of this paper is to evaluate the performance of 9 European airline companies based on a balanced scorecard approach. It is a very popular approach in performance measurement, especially in the last few years. There are four different perspectives of the balanced scorecard approach: customer, finance, internal process, and learning and growth. In other words, it considers both financial and non-financial aspects in order to provide a more effective performance assessment.

Additionally, the hybrid multicriteria decision-making approach was also used in this study in order to reach this objective. Within this scope, the combination of three different methods (Fuzzy DEMATEL, Fuzzy ANP and MOORA) was taken into the consideration in the analysis process. This increased the originality of this study with respect to the methodology. As a result of this evaluation, it will be possible to make recommendations for the European airline companies to improve their performance.

According to the result of this analysis, it was identified that the customer dimension is the most important dimension of the balanced scorecard, while the dimension of learning and growth has the lowest importance. This shows that European airline companies, which are successful regarding customer dimension, have a higher performance in comparison with others. Additionally, it can also be understood from these results that variables regarding the learning and growth perspective of the balanced scorecard cannot be accepted as the indicators of the performance of European airline companies.

Another result of this analysis is that the dimensions of customer and finance have had significant impacts on the other dimensions of the balanced scorecard. On the other hand, the dimension of learning and growth has not had any impact on the other perspectives of balanced scorecard. While considering these results, it can be said that increasing the performance of the indicators related to customer and finance perspectives have also had an increasing effect on other perspectives. Therefore, they play a more important role in increasing the performance of these companies.

Furthermore, profit per customer is the most significant key factor; whereas, current ratio has the lowest importance in the balanced scorecard perspectives according to the results of limit supermatrix. In other words, customer profitability is accepted as the most important signal that shows the performance of European airline companies. Comparatively, it was also identified that the variable of current ratio plays a less important role with respect to the performance of these companies.

In addition to those conditions, it was also determined that the airline companies, which have high levels of profit per employee, took the highest scores in comparison with the others. Another important point is that airline companies, which had the highest scores, have the highest values of the ratios of "number of the passengers/number of seats", number of the flights/number of employee" and "number of passengers/number of employee". These issues demonstrate that profitability and efficiency are the most significant concepts in order for airline companies to improve their performance.

In addition to those aspects, the results of the sensitivity analysis show that A4 is the best airline company in the multidimensional performance evaluation based on balanced scorecard except for the Cases 8 and 11. On the other side, it was also identified that A9 is the worst airline company in most of the cases. In summary, these results of the integrated fuzzy-based method with the sensitivity analysis verify the robustness of the proposed hybrid model.

It is recommended that European airline companies should firstly focus on the customer perspective of the balanced scorecard approach so as to increase their competitive powers. In other words, in order to survive in this competitive market, these companies should satisfy the needs of the customers. Thus, it will be possible for these firms to provide efficiency and profitability. While considering all these aspects, it can be said that this study makes an important contribution to the literature by helping to minimize a significant problem with an original methodology. For further studies, the paper could be extended by using the other companies located worldwide, and comparing the different hybrid, multi-criteria decision-making models.

In this study, only 9 European airline companies were taken into the consideration. The main reason for this situation is that there is a limitation related to the dataset of airline companies. Another important limitation related to this study is that it is very difficult to obtain the data for non-financial variables-some important indicators cannot be considered in this study. While considering these aspects, it must be said that a new study, which contains more non-financial variables and higher number of airline companies, would be very beneficial for literature.

Appendix A

Unweighted supermatrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
C1	0	0	0	0	0	0.20	0.20	0.21	0	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0.21	0.21	0.22	0	0	0	0	0	0	0	0	0
C3	0	0	0	0	0	0.20	0.20	0.20	0	0	0	0	0	0	0	0	0
C4	0	0	0	0	0	0.20	0.20	0.19	0	0	0	0	0	0	0	0	0
C5	0	0	0	0	0	0.19	0.19	0.18	0	0	0	0	0	0	0	0	0
C6	0.36	0.39	0.62	0.34	0.34	0	0	0	0.39	0.47	0.45	0.40	0.37	0.37	0.35	0.39	0.55
C7	0.36	0.34	0.29	0.32	0.32	0	0	0	0.32	0.28	0.34	0.35	0.33	0.37	0.33	0.30	0.24
C8	0.27	0.28	0.09	0.34	0.34	0	0	0	0.30	0.25	0.21	0.25	0.31	0.34	0.31	0.31	0.22
C9	0.19	0.19	0.20	0.20	0.20	0.28	0.21	0.19	0	0	0	0	0	0	0.20	0.19	0.20
C10	0.07	0.07	0.06	0.07	0.07	0.06	0.06	0.07	0	0	0	0	0	0	0.07	0.07	0.07
C11	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.19	0	0	0	0	0	0	0.19	0.19	0.19
C12	0.20	0.20	0.21	0.19	0.19	0.19	0.20	0.19	0	0	0	0	0	0	0.19	0.19	0.19
C13	0.18	0.18	0.19	0.19	0.19	0.17	0.18	0.19	0	0	0	0	0	0	0.18	0.19	0.18
C14	0.17	0.17	0.15	0.16	0.16	0.10	0.15	0.17	0	0	0	0	0	0	0.17	0.17	0.17
C15	0.35	0.35	0.35	0.39	0.39	0.35	0.39	0.49	0.37	0.39	0.36	0.36	0.39	0.39	0	0	0
C16	0.35	0.35	0.35	0.33	0.33	0.33	0.33	0.34	0.32	0.30	0.32	0.36	0.33	0.33	0	0	0
C17	0.31	0.31	0.31	0.28	0.28	0.31	0.28	0.17	0.31	0.31	0.32	0.28	0.28	0.28	0	0	0

Appendix B

Limit supermatrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
C1	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
C2	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
C3	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
C4	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
C5	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
C6	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.131
C7	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101
C8	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089
C9	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
C10	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
C11	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
C12	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
C13	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052	0.052
C14	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
C15	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109
C16	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095
C17	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081

Appendix C

Weighted supermatrix.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17
C1	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C2	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C3	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C4	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C5	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C6	0.12	0.13	0.21	0.11	0.11	0.00	0.00	0.00	0.19	0.24	0.23	0.20	0.18	0.18	0.18	0.19	0.27
C7	0.12	0.11	0.10	0.11	0.11	0.00	0.00	0.00	0.16	0.14	0.17	0.18	0.16	0.18	0.17	0.15	0.12
C8	0.09	0.09	0.03	0.11	0.11	0.00	0.00	0.00	0.15	0.12	0.10	0.12	0.15	0.16	0.16	0.16	0.11
C9	0.06	0.06	0.07	0.07	0.07	0.09	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.09	0.10
C10	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
C11	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10
C12	0.07	0.07	0.07	0.06	0.06	0.06	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.10
C13	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.09
C14	0.06	0.06	0.05	0.05	0.05	0.03	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.09	0.08
C15	0.12	0.12	0.12	0.13	0.13	0.12	0.13	0.16	0.18	0.19	0.18	0.18	0.19	0.19	0.00	0.00	0.00
C16	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.11	0.16	0.15	0.16	0.18	0.17	0.16	0.00	0.00	0.00
C17	0.10	0.10	0.10	0.09	0.09	0.10	0.09	0.06	0.16	0.16	0.16	0.14	0.14	0.13	0.00	0.00	0.00

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