Sustainability Reporting of Airlines: Performances and Driving Factors in Environmental Aspect

by

Xudong Chen

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Department of Supply Chain Management

I.H. Asper School of Business

University of Manitoba

Winnipeg, Manitoba, Canada

Abstract

In recent years, sustainable development has become a critical area of concern in the aviation industry. The number of airlines that incorporate sustainability into their business is increasing to enhance their market positions and profitability. Sustainability reporting is an efficient and straightforward way to understand how airlines do in related fields. In this paper, we develop a scoring system for the environmental components in airlines' sustainability reports. Then we build a statistical model to test the relationships between airlines' sustainability reporting performance and multiple factors. The thesis finds that the size of an airline (RPK) and the environmental performance index (EPI) of its home country are both positively correlated with the airline's sustainability reporting performance. Besides, if an airline is listed in any market, it has better reporting performance. Furthermore, Star Alliance members have a better chance to perform better than other airlines in their sustainability reporting. Contradictory to intuition, full-service carriers and low-cost carriers are not significantly different in terms of their reporting performances.

Key words: sustainability reporting; airline; environmental performance index; alliance

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Chapter 1 Introduction

Environmental degradation, resource depletion, global warming, climate change, and human rights violations have become four increasingly concerning topics and prompted more and more companies to engage in socially responsible business practices (Mayer, 2007). Those issues forced organizations to pay attention to and solve these problems (Butler et al., 2011). A business approach, sustainable development, considers the company's responsibility to the society based on what previously focused only on economic development. While a company is generating profits, it should also desire to give back to employees' families, the environment, and the society. Such a sustainable practice benefits all the parties interested in a company and is the prerequisite for the survival and development of a company (Rajnović et al., 2019). In addition, stakeholders' requirements for accountability make multinational companies more aware of the call and importance of sustainable development (Dodds & Kuehnel, 2010). This makes publishing a separate sustainability report a dedicating tool for companies to demonstrate corporate social responsibility and environmental protection initiatives (Farooque et al., 2017).

Among all industries, tourism, transportation, mining, and energy industries, because of their substantial impacts on the environment and the society, have become the main concern of sustainability research. As one of the main transportation modes, aviation contributes significant impact not only on economic development, but also on the environment. The gross domestic product (GDP) of world aviation industry has achieved around 691.3 billion dollars (ATAG, 2020). However, it has discharged 915 million tonnes of CO2 in 2019 worldwide, contributing to 2% of the total CO2 emission globally (ATAG, 2020). Together with non-CO2 emissions, its contribution to the global warming approximately doubles. Because of the surging demand for air transportation, global aviation could account for 22% overall CO2 emission by 2050 (Cames

et al., 2015). Meanwhile, climate change itself is and will still be an increased focus area for both business and politics (Seignette, 2019), which has a direct correlation to airline performance (Leamon et al., 2019).

Although airlines are starting to renovate their fleets with new technology (Caetano & Alves, 2019), reducing greenhouse gas (GHG) emission is still a big challenge (Smith & Rodger, 2008; Leamon et al., 2019). Many airlines are pursuing sustainability by switching from regular fossil fuels to biofuels and other methods to achieve a more continuous and self-recovering social and environmental atmosphere. Aircrafts also cause noise pollution and energy wastage (Schäfer & Waitz, 2014). To make the issue more complex, aviation is linked to a wide-range group of stakeholders whose interests may conflict with each other (Ndolo & Njagi, 2016). A suitable strategic goal must be set to meet all stakeholders' benefits. Therefore, a clear and transparent sustainability report may be an effective and essential way to present the balance of interests of all stakeholders(Simoni et al., 2020). Consequently, airlines should have strong incentives to devote funds and resources to pursue ideal sustainability reports. However, the fact is that the qualities of sustainability reports from different airlines are uneven. At the moment, sustainability reporting is not yet a common practice among airlines, although more and more airlines publish their sustainability reports (Kuo et al., 2016). This variation in reporting quality suggests that there must be some driving factors affecting the performance of airlines' sustainability reporting, motivating the reporting behaviour, and making the attitudes towards sustainability reporting different. Meanwhile, to have a deeper understanding of the reasons behind and to improve readers' understanding of the performance of sustainability reports in aviation industry, it is meaningful to examine what factors affect airlines' reporting performance and how they work.

This thesis firstly develops a scoring system for the environmental disclosures in airlines' sustainability reports. The world's top 100 airlines are scored based on their revenue passenger kilometers (RPK) in the year of 2017. Then a regression test is carried out to test the relationships between the airline's sustainability reporting performance and multiple factors, including the size of the airline, its home country's EPI, its home country's GDP, its continent, its business model (full-service carrier vs. low-cost carrier), whether it is listed, and whether it belongs to one of the global airline alliances. The thesis finds that the size of an airline (RPK) and the environmental performance index (EPI) of its home country are both positively correlated with the airline's sustainability reporting performance. Besides, if an airline is listed in any market, it has better reporting performance. Furthermore, Star Alliance members have a better chance to perform better than other airlines in their sustainability reporting. Contradictory to intuition, full-service carriers and low-cost carriers are not significantly different in terms of their reporting performances.

The contribution of this paper is two-fold. First, as far as we know, this is a pioneer paper to evaluate airlines' sustainability performances, which can serve as a good start point for assessing how well each airline publicizes its effort in sustainability environmental practices. Second, it is also the first paper to endeavour in finding out the factors that affect sustainability environmental reporting performance, through which we can obtain a better understanding regarding what are behind the different reporting qualities within the aviation industry.

Chapter 2 Literature Review

2.1 Sustainable development

At the very beginning, the concept of sustainable development was based on the development of society. However, more and more companies are starting to consider it by taking the corporation as a unit (Steurer et al., 2005). If sustainable development is defined as a continuous growth in material consumption, this concept cannot be fairly interpreted when we meet the ultimate limit to usable recourses exist (Brundtland, 1987). The sustainable development then was defined as a growth in social welfare because a growth in economic output does not necessarily mean the growth in physical materials (Pezzey, 1989) when it is focused on the economic side. A widely accepted definition is "the development meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987)." This definition sets the cornerstone for sustainable development. However, a better definition should be more precise in its concept and allow more diverse and flexible methods in developing strategies that may lead society, economy and environment to a self-sufficiency (Lele, 1991).

This concept from WCED (1987) has been generally accepted by different industries, such as manufacturing, mining, transportation. (Environment Canada, 2010).

2.2 Sustainability reporting

The predecessor of sustainability report is corporate social responsibility (CSR), which mainly focus on one corporation's responsibility on non-financial aspects (Rob et al., 1995). In aviation, some airlines consider sustainability as a part in CSR, while others use sustainability reports to replace CSR or even integrate sustainable development chapter into their financial report. The reason why these airlines are reporting the sustainability aspect differently is not

clear yet. According to sustainability triple bottom line perspective, sustainable development needs to consider social (ethical), ecological and business development simultaneously (Slaper & Hall, 2011). Thus, airlines need to touch these parts financially and ideologically no matter whether it is spontaneous or is under the pressure from its stakeholders. In the process of this report development, different airlines are on different phases. Therefore, we can notice this difference in their ways of reporting from reports.

There are two goals of sustainability reporting. One is to picture a corporation's expectation of future impact on social, economic, and environmental aspects. The other is to present achievements in those three sustainability aspects in the last year (Satterfield et al., 2009). Sustainability reports also present corporate's sustainability development phase and strategy to interior and exterior stakeholders (Massa et al., 2015). Sustainability reporting could be an annual assessment about a corporation's economic, environmental and social implementation (Dissanayake et al., 2016). It's also a tactical statement affecting environment, economy and society, which declares the tasks, chances and concerns in the sustainable development (Geng et al., 2017). Therefore, sustainability reports can be a way to show that companies can maintain their business competitiveness with environmental and social responsibilities.

In the process of producing sustainability reports, employees from different departments are trying to perform how they are collaborating to construct a more sustainable atmosphere in the company. On the other hand, all stakeholders are essentially involved and receive information from the corporation through sustainability reports. Hence, they can estimate corporation's performance in sustainable development and determine the sustainability level of this corporation among others (Leszczynska, 2012). In a corporation's perspective, the goal of sustainable development should be consistent with its long-term goal so that the corporation can

achieve a both sustainable and healthy development in all three sustainable aspects. Considering the short-term goal of sustainable development is always changing due to the reality, a company must pay more attention on the short-term goals to meet the needs of every stakeholder timely.

Some extant research have done valuable work on the sustainability reporting in the aviation industry. A series of studies examined independent reports issued by airlines to determine their sustainability practices and disclosures. Cowper-smith and Grosbois (2011) explored the CSR through qualitative content analysis. Their research shows that airlines are concerned with environmental issues, not social or economic dimensions of CSR. Wang et al. (2013) evaluate the CSR performance of eight Chinese airlines using entropy weight and grey relation analysis. They found that corporate social responsibility disclosure is positively related with firm size, media exposure, share ownership concentration and institutional shareholding. Some studies conducted surveys or case studies to explore the factors that influence airlines' CSR practices. For instance, Sheldon and Park (2011) conducted a survey-based study to explore the CSR concepts and practices of the US tourism industry, including some airlines. Kuo et al. (2016) also conduct a survey and confirmatory interviews to determine the incentives and difficulties of CSR practices in the aviation industry. Lynes and Andrachuk (2008) applied an in-depth case study approach to Scandinavian airlines to determine why companies are committed to corporate social and environmental reasonability practice. Kearins and Fryer (2011) also used case study methods to study how sustainability theory relates to practice of Auckland Airport. Lee and Park (2010) studied the impact of CSR on the performance of seven airlines, including a 46-year annual company observation.

On the other hand, previous researches are mainly focused on issues or topics about how to offset or reduce GHG emission (Johnson & Gonzalez, 2013). However, those driving factors

behind sustainability reporting performance are overlooked. Those factors may not have direct influence on reporting activity. Because there are sustainability reports with different reporting qualities and disclosure extent in the aviation industry, those factors should be found out to understand why those factors have influence on it, and how they can affect reporting behaviour. Therefore, more attention should be paid on finding out what driving factors behind sustainability reporting performance are. This thesis will fill in the research gap by investigating these factors and their roles and influence.

2.3 Global reporting initiative

Inclusive announcement through appropriate social documents helps airlines maintain and reinforce connection with stakeholders. Since sustainability report is a way for airline corporations to communicate with other stakeholders, a mature standard is necessary. Some guidelines (such as ISO 2600, GRI) provide a clear and neat construction for airlines. GRI Guideline was issued in 1999 to help companies to construct an exhaustive and clear sustainability report and created a standard for corporations worldwide to improve the sustainability reporting performance. The sustainability reporting performance can be greatly improved if companies can follow it thoroughly (Fonseca et al., 2012). Nowadays more and more corporations start to use GRI Guideline as the template of their sustainability reports, although not all sections mentioned in GRI Guideline is suitable for airlines to improve their sustainability reporting performance. The main goal of GRI is to establish its reporting procedures as a globally recognized framework that promotes comparability in sustainability reporting (Einwiller et al., 2015). According to GRI Guideline, a basic disclosure should include economic, environmental and social categories (GRI, 2018). In this paper, GRI environmental

aspect is used as the guideline to score the reports collected from airlines' website.

Chapter 3 Theoretical Frameworks

3.1 Agency Theory

Agency theory was originally proposed by Jensen & Meckling in 1976. It was established in the information economics literature to explains the relationships between principals and agents under the assumption of information asymmetry and conflicts of interests (Eisenhardt, 1989). This theory later developed into a contracting cost theory. The contracting cost theory assumes that an enterprise consists of a series of contracts, including contractual relationships between providers of capital (shareholders and creditors, etc.) and capital operators (management authorities), enterprises and lenders, enterprises and customers, and enterprises and employees.

The agency theory mainly involves the contractual relationship between the provider of the enterprise resource and the user of the resource. According to agency theory, the owner of economic resources is the principle: the manager responsible for the use and control of these resources is the agent. The agency theory holds that when the managers themselves are the owners of the resources, they have all the residual claims of the enterprise, and the managers will work hard for it and for himself. In this environment, there is no principle-agency problem. However, when managers draw new resources from the outside, managers will have a motivation to increase on-the-job consumption, relax themselves and reduce work intensity. Obviously, if the manager of the company is a homo economicus. His behaviour will be significantly different. Jensen & Meckling separated agency costs into monitoring costs, bonding costs, and residual losses. The monitoring costs refer to the expenses incurred by external shareholders to supervise the excessive consumption or self-relaxation of the managers; the self-constrained expenditures incurred by the agents in order to obtain the trust of the external shareholders (such as regularly reporting the operation to the client, hiring an external independent audit) is called the bonding

costs; Other losses due to inconsistent interests of the principal and the agent are residual losses.

Meanwhile, information asymmetry exists because managers can deal with superior information about current and future financial and non-financial information about company performance, but company shareholders can not (Ho & Taylor, 2013). To eliminate information asymmetry between companies and shareholders, companies would use some different communication channels to inform shareholders (Brammer & Pavelin, 2008). Therefore, in aviation, airlines would like to conduct sustainability reports with GRI as a guideline to reduce the agency problems brought by information asymmetry and reducing agency cost.

3.2 Institutional Theory

The institutional theory offers an advantageous framework for understanding how and why institutional effects occur within and around organizations, explaining how social choices are shaped, promoted, and guided through the influence of institutional environments (Contrafatto, 2014). These organizations are located in a recognized area which has key suppliers, resource and product consumers, regulatory agencies and other organizations that produce similar services or products (P. J. DiMaggio & Powell, 1983). In this organizational fields, organizations are rewarded for staying in the border through legitimacy, resources and survival capabilities (Scott, 1987). Once this border is formed, various powers will force organizations within the field to become similar to each other. Scott (1995) introduced a valuable approach to understanding institutional influence by identifying three key critical elements: regulative, normative and cultural-cognitive. These elements are considered to deliver stability and meaning to organizations. The regulatory system involves rulemaking, monitoring and sanctioning activities that limit and regulated behaviour. The normative system includes social values and norms, creating social expectations in pursuit of organizational goals and objectives. These values and

norms are inherently normative and set expectations for shaping the behaviour of organizational actors. The cultural cognition system includes assumptions that are taken for granted and a common understanding through the other organizations in the same environment.

Powell & DiMaggio (2012) believe that modern organizations show great similarities in form and practice. Once the organizational field is formed, there will be a great momentum of homogeneity. To understand this homogeneity, the most appropriate concept is an institutional isomorphism, which refers to the similarity between structure and practice of an organization and other organizations in the same environment. The concept of institutional isomorphism is a useful tool for understanding politics and rituals that permeate the life of modern organizations.

Institutional isomorphism consists of three basic forms:

1. Coercion isomorphism. Coercion isomorphism stems from the formal or informal pressure exerted by other organizations on which it depends and social and cultural expectations.

2. Imitate isomorphism. Not all institutional isomorphism comes from coercion isomorphism. Uncertainty is a powerful force that encourages imitation. When organizational skills are difficult to understand, goals are blurred, or when the environment creates symbolic uncertainty, organizations can shape themselves in the form of other organizations. Although they are looking for diversity, there are only a few variables to choose from. The phenomenon of the new organization imitating the old organization exists throughout the economic field, and managers are actively looking for models that can be imitated.

3. Normative isomorphism. Normative isomorphism is mainly derived from professionalism, that is, formal education based on the cognition created by the university, and the development and deepening of professional networks that can spread new models rapidly across organizations.

As Powell & DiMaggio (2012) say, institutional theory helps explain the facts we observed that organizations become more and more homogeneous, and at the same time, enable people to understand the irrationality which is common in organizations and lack of innovation. Focusing on the isomorphism of the system can also strengthen the view on political struggle for organizational power and survival. Thinking about the isomorphism process also makes us focus on power and its application in modern politics.

The institutional theory for sustainability reporting argues that sustainability reporting is not necessarily an organizational act with clear reasons, but rather mimics seemingly more successful and legitimate peer organizations (Bebbington et al., 2009; Islam & Deegan, 2008). Different regulatory systems effect the evolution of sustainability reporting. For instance, environmental regulations and industry legislation that are prevalent in some countries act as mandatory pressures, forcing companies to comply with their structures and rules to ensure legitimacy. Researchers have found that global institutional pressures tend to replace local influences (Islam & Deegan, 2008; Kamla, 2007; Kuasirikun & Sherer, 2004). The process of global institutionalization is mainly achieved through GRI (Brown et al., 2009). Importantly, GRI does not specify how metrics must be reported, but provides guidelines on the content of reports and the quality principles that should be sought. GRI adoption will help airlines to gain their legitimacy as a responsible member in organizational field by following the norms. Participants in the GRI include multilateral organizations such as the United Nations Environment Programme (UNEP), large multinational corporations, international consulting firms (AccountAbility, SustainAbility) and large accounting firms. These participants and their levels of engagement with the GRI, together with their interactions with one another, stimulate the field of sustainability reporting and lead to standardisation.

Chapter 4 Reporting Performance Scoring

The first step of analysis is to score the report performance. After comparing the advantages and disadvantages of various scoring methods, the scoring system from Yadava & Sinha (2016) is referenced for our analysis. This thesis uses a 0-3 scoring scale which gives a score based on the following standard, as shown in Table 1.

Table 1 *Rating Qualification Scale*

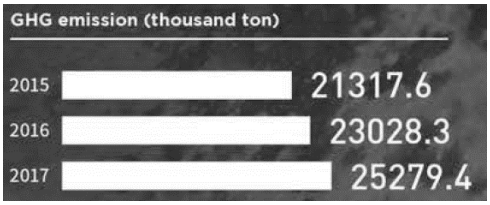
Points	Rating qualifications/requirements	Example
0	The report does not mention any information relevant to the specific GRI topic.	-
1	The report provides generic or brief statements on the related topic.	In March 2018 Ryanair launched its Environmental Policy Document which commits to ambitious future environmental targets building on impressive achievements to date, including commitments to address climate change, and the priorities and policies which will allow Ryanair to continue to lower CO2 emissions and noise pollution. (Ryanair annual report 2018)
2	The report includes valuable, detailed information on the topic but there is only 1-year data.	See Table 2.
3	The report provides adequate, detailed information which covers more than 1-year data in a comparable form.	See Figure 1.

Table 2 *Example for Giving a 2 Point*

Etihad Aviation Group 2017 Carbon Footprint				
Scope 1	Total Usage	Unit	Conversion Factor	Tonnes of CO2
Aircraft	3,450,732,806	kg	3.15 tCO2/ton	10,869,808
Ground vehicle (petrol)	2,294,703	litre	2.3 kgCO2/litre	5,278
Ground vehicle (diesel)	1,234,417	litre	2.7 kgCO2/litre	3,333

From: Etihad Airways Sustainability Report (2017)

Figure 1 *Example for Giving a 3 Point*



From: China Southern Airlines Corporate Social Responsibility (2017)

However, due to the specific features of the aviation industry, certain adjustments with the scoring system are necessary to obtain more appropriate results. Some indicators may not be suitable for airlines, such as biodiversity related indicators and reclaiming the products packaging. Although some airlines are following the GRI Guideline strictly, those indicators are either irrelevant or unimportant for the aviation industry. In the future, with more resources dedicates into sustainable development, airlines may be able to have a chance to touch on these aspects. But for now, the priority of these indicators is not as high as the one of other aspects like usage, water pollutions, noise pollutions, and GHG emissions. Because the GRI Guideline does not differentiate for different industry, it is critical to apply different weights on different factors or indicators for different industry. Detailed changes and explanations are mentioned as following:

1. According to the GRI Standard, for example, GRI 302-1 (or G4-EN3 in GRI-G4) Energy

Consumption Within the Organization asked organization to report the total fuel consumption from non-renewable sources, even including electricity and cooling energy consumption. As the actual fuel consumption in the aviation industry is mainly aviation fuel. In the scoring process, if the company mentions only one sort of consumption from non-renewable fuel sources, mainly the jet fuel, it can be considered as reported. And if the data provided are more than 1 year, it is given a 3 point.

2. The aspects that can be reported and included in the sustainability reports are different among different airlines due to their ability to reach those data. If the information provided by airlines are like ‘we are not able to do it right now’ or ‘we don’t have this kind of concern’ or ‘we are not able to track the data now’, it is treated as a not-reported and given a 0 score.

3. For GRI 306-3 (or G4-EN24 in GRI-G4), total number and volume of significant spills, if it is mentioned in the reports that ‘there is no fine or noise complain’ in last financial year, it will be given a 2 because it can be considered as a zero in fine.

We use the system introduced in above to score the world’s top 100 airlines according to their traffic volumes (RPKs) in 2017. The scores are presented in Table 4 (See Appendix A).

Insert Table 4 about here

There are 100 airlines on the list. By searching each company's website, a total of 82 related reports were collected. Among these 82 reports, 17 were using GRI Standard as a reporting guideline. 21 were using GRI G4, and 44 were not referring any GRI reporting guideline.

Figure 2 *Proportion of Reports According to GRI Guideline*

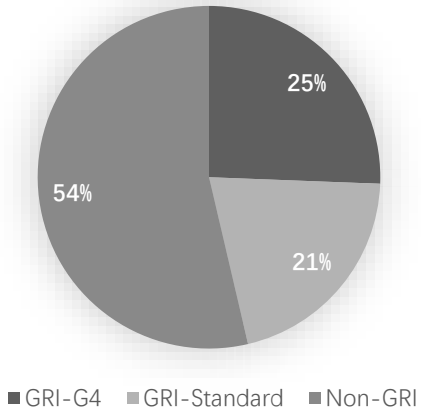
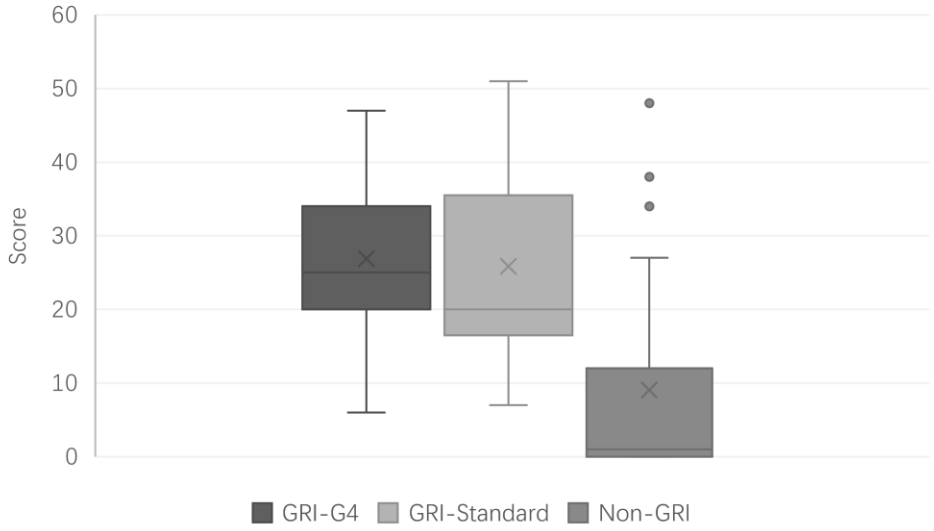


Figure 3 *Distributions of Scores Among Different Reporting Guidelines*



And if a report title can be considered as a way that company selects to communicate with public what the report wants to cover, 27 reports were clearly titled as a “Sustainability Report” while 17 were called “Corporate Social Responsibility” and 19 were simply has a section or related informative section in their Annual Reports.

Chapter 5 Hypotheses

5.1 Airline size

Company size is one of the most commonly used variable for understanding corporate social and environmental reporting practices (Skouloudis et al., 2011; Ho & Taylor, 2013; Nazari et al., 2015;). Several reasons can be identified for those positive relationships. First, agency theory states that large companies have higher agency costs due to more information asymmetry between managers and shareholders (Jensen & Meckling, 1976b). Intuitively, large companies will disclose more information to reduce agency costs than small companies will. Therefore, the sustainability report will provide a platform for large companies to report other information about their operations, thereby reducing information asymmetry with shareholders. Second, larger companies may be more inclined to disclose their CSR practices because they may suffer more losses due to lack of legitimacy (Delen et al., 2013). Furthermore, large companies are scrutinized by public and are expected to face stronger pressures from groups that advocate a green environment and improve social welfare (Naser et al., 2006). To alleviate this pressure, large companies are more inclined to volunteer to participate in socially and environmentally responsible activities (Veronica Siregar & Bachtiar, 2010). As a result, small companies avoid voluntary disclosure of information about their business because they fear losing their competitive advantage. In the aviation industry, revenue passenger kilometers (RPK) measures actual demand for transportation. It could also be referred as airline traffic, so RPK can be used as a measure for company size. Based on the above discussion, we raise the following hypothesis.

H_1: Airline size has a significantly positive association with environmental sustainability reporting performance.

5.2 Regional difference

Regional differences are more about emphasizing areas among continents or among cultural blocks. The cultural practices could be one of the source of institutional pressures (P. DiMaggio & Powell, 1983). The cultural cognition systems can be considered as a system built based on geographical difference, which means airlines located in the same area would probably have similar behaviour on their reporting process and similar understanding about environmental sustainability reports. The same reason can also be applied to customers' side. Customers from same area or close areas may have a very high possibility to have a similar prospect of view or focus when looking at the related issues. In addition to the cultural background, regional normative restrictions are one of the considerations. Some of previous researches have already shown the link between characteristics of the country where the company located and sustainability assurance statements (Paulo Perego, 2009; Kolk & Perego, 2010; Paolo Perego & Kolk, 2012; Fernandez-Feijoo et al., 2015). Moreover, local regulations may also have an influence on the requirements of sustainability reporting. Sustainability policies are different from city to city as well (Karlenzig, 2008). Based on cultural similarities, this research divided regions into North America, Europe, Asia Pacific, Middle East, Latin America, and Africa. The environmental performance index (EPI) is a quantitative measure of environmental performance in national policies (Wendling et al., 2018). The EPI is calculated through a framework that contains 32 indicators with different weights from 11 categories which are based on two policy objectives, environmental health, and ecosystem vitality(Wendling et al., 2018). It is used, in the thesis, to assess issues related to environmental sustainability in countries. To present the difference more accurately, EPI categorized by countries are also included to show the impact on these airlines from their mother countries as well as GDP. Following the above discussion, three

more hypotheses can be proposed.

H_2: Regional difference has a significant association with environmental sustainability reporting.

H_3: Airlines located in a country with higher EPI performs better than other airlines located in a country with lower EPI in environmental sustainability reporting.

H_4: Airlines located in a country with higher GDP performs better than other airlines located in a country with lower GDP in environmental sustainability reporting.

5.3 Listing status

Due to the high degree of information asymmetry and the conflict of interest between shareholders and managers, the agency costs of listed companies are higher (Fama & Jensen, 1983). Therefore, the company will propose more disclosures to alleviate information asymmetry (Reverte, 2009) and reduce agency costs (Alsaeed, 2006). In addition, listed companies will have more stakeholders and more visibility in the public domain (Kiliç et al., 2015), which makes a transparent report essential. Stock Exchanges can also play an significant role in constructing transparency of sustainability related topics and risks (Kalinowski, 2014). In several international policies, transparency on social and environmental matters are emphasized. Sustainability reports based on ratings seem to be a tool of choice for communication, which can encourage transparency of corporate sustainability indicators without mandatory rules. These indexes highlight the best performers. In the long run, it will help investors apply pressures on companies and establish competition between companies to drive information disclosure and ultimately improve performance. A study from 2014 investigated the sustainability reports from Portugal, which showed that the listing status is one of the factors influencing the sustainability reporting

assurance (Branco et al., 2014). In contrast, non-listed companies will be less willing to disclose voluntary information because these shareholders can get information directly from the company (Naser et al., 2006; Reverte, 2009). In addition, listed companies are more likely to incorporate environmentally responsible practices into their strategies to attract more investors. Consequently, we develop the following hypothesis.

H_5: Listed airlines have better sustainability reporting performance than those are not listed in environmental aspect.

5.4 Pressure from alliance

In the institutional theory, it is mentioned that in the same market environment, members tend to make similar decisions due to uncertainty and legitimacy. The institutional theory is also used for explain why companies adopt such green practices in supply chain (González et al., 2008; Wu et al., 2012). Normative, coercive and mimetic pressures are three forms of institutional pressures that are responsible for driving isomorphism and lead organization to what is legitimate (P. DiMaggio & Powell, 1983). Normative institutions can be trade associations, professional associations and accreditation bodies, as they build guides of appropriate conduct (Grewal & Dharwadkar, 2002). Industry associations promote their associational reputation which can lead to a similar standard and spread to association members (Grewal & Dharwadkar, 2002; Castka & Balzarova, 2008). Sustainability standards adoption is a response from a company under the close attention from social and environmental ombudsmen (Wijen, 2014). The greater an association's involvement is, the most likely a member will resemble those in the association (P. J. DiMaggio & Powell, 1983). It has been found that an industry peer can make a huge influence on a company's environmental strategy (Bansal & Roth, 2000; Park-Poaps &

Rees, 2010). From an airline perspective, it may be beneficial to form or join an alliance for several reasons. First, the airline can extend its operating network coverage to achieve economies of scale and density. Second, the alliance has established close ties among member companies, which helps to form more forms of cooperation, such as joint ventures, franchises and even mergers. Among the different alliances, there are members from different countries. These members indirectly influence and limit the behaviours of other members in the alliance. These cultural identities come from different airlines. To maintain alliances, alliance members must yield to influential alliance members for more recourse. Currently the three main aviation alliances are Oneworld, Sky Team, and Star Alliance. Star Alliance has the most members, followed by Sky Team and finally Oneworld. Therefore, we recommend the following assumptions:

H_6: Alliance members have a better sustainability reporting performance than non-alliance members in environmental aspect.

H_7: Different alliances have a significant association with environmental sustainability reporting performance.

5.5 Business modal

A business model can be considered as a conceptual tool that includes a bunch of elements and relationships that describe a company's logic for establishing the company, doing their business and delivering their values (Magretta, 2002; Osterwalder & Pigneur, 2010; Teece, 2010). A business model can also give a company ability to adapt itself to the industrial environment (Teece, 2010). It can be very crucial for a business model in practicing sustainability and improving the sustainability values that is delivering by this company (Stubbs & Cocklin, 2008). Airline companies can be roughly separated into two different business

models, full-service carriers, and low-cost carriers. As the name suggests, the low-cost carrier business model includes several characteristics. Low-cost carriers primarily run point-to-point short-haul routes, focus on price-sensitive passengers, offers low average fares, and only own a fleet of just one or two aircraft types, comparing with full-service carriers. The products they are offering, their company structure and operational procedures can be totally different from full-service carriers. Basically, they are focusing on two different types of passengers which may have different needs and views. On the other side, to achieve a low-cost, airlines must cut unnecessary cost and dedicate all the resources on the primary service. This could lead to a totally different attitude on sustainable development aspect.

H_8: Full-service carriers perform better than lower cost carriers in environmental sustainability reporting.

Chapter 6 Methodology

To have a better understanding of those driving factors, top 100 airlines ranked by Revenue Passenger Kilometres (RPK) in 2017 are selected as a sample. The RPK is an airline industry metric that shows the number of kilometres travelled by paying passengers. It is calculated as the number of revenue passengers multiplied by the total distance traveled measuring the actual demand for air transportation. On the other hand, RPK also reflects the traffic operated by those airline companies. Those airlines selected are from North America (16%), Europe (27%), Asia Pacific (38%), Middle East (9%), Latin America (8%) and Africa (2%). Business model is divided into full-service carriers (69.70%) and low-cost carriers (30.30%).

Figure 4 *Distribution of Samples According to Its Region*

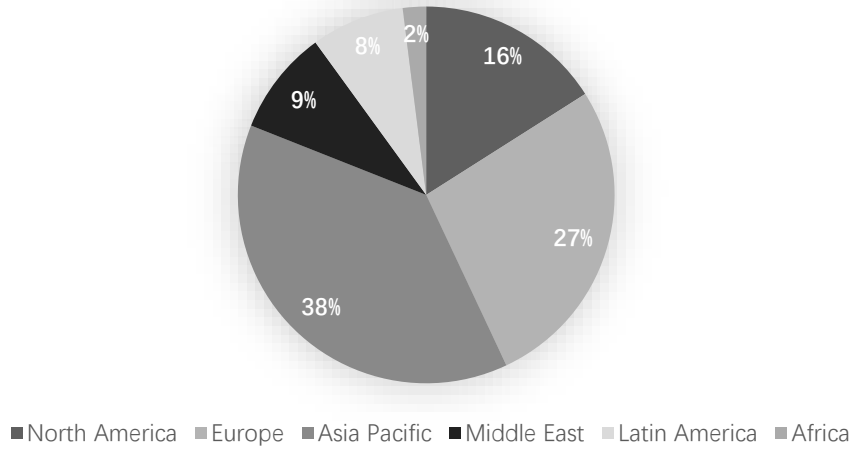
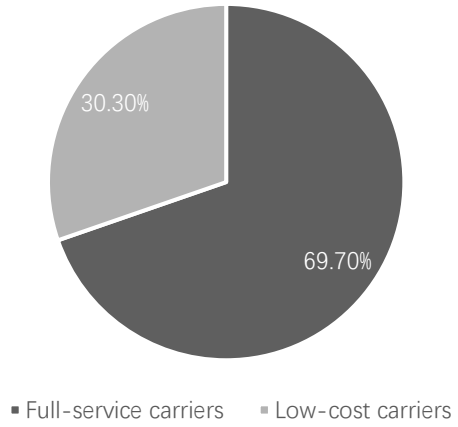


Figure 5 *Distribution of Samples According to Its Business Model*



Reports are collected from the airlines' websites, including annual reports, corporate social responsibility reports, integrated reports, environmental reports, and sustainability reports. Annual reports are included in this thesis because some airlines integrate sustainability sections into their annual reports.

Because the RPK ranking was published and ranked in 2017, this research selects the most recent reports that can be found on their websites. Because this research is digging into the reporting performance, collected reports are not necessary to be describing the same period. Besides, the financial year of different airlines are defined differently. Reports were all collected between Dec. 24, 2018 and Dec. 31, 2018 to obtain the most accurate data to describe the situation of a certain airlines in that time. Data for those driving factors are collected from their own reports or websites or from other sources. Data about alliance status can be found from airline alliance websites, such as Oneworld.com, Skyteam.com and Staralliance.com. Some airline alliances, such as Vanilla Alliance, U-FLY Alliance, and Value Alliance, are not included in this research because they focus more on regional markets. Moreover, data related to the business model (Low-cost carrier or full-service carrier) are collected through a list of low-cost carriers from International Civil Aviation Organization (ICAO). If a certain airline is not found

on the list, then it is considered as a full-service carrier.

Chapter 7 Data Analysis

RStudio (1.3.959) is used to test the hypotheses in this research. The code is shown in the Appendix D. Packages used in the model testing are car (3.0-10), carData (3.0-4), and leaps (3.1).

In this research, the independent variables that need to be tested are revenue passenger kilometers (RPK), locations of airlines' headquarters, environmental performance index (EPI), listing status, business model, alliance status and gross domestic product (GDP) of their mother countries. And the dependent variable is the scores based on their environmental sustainability reporting performance according to the scoring standard mentioned in Chapter 4. An example dataset can be found in Appendix D and E.

The original formula and regression results are as following:

$$\begin{aligned} env_{score} = {} & \beta_1 \times rpk + \beta_2 \times northamerica + \beta_3 \times asia + \beta_4 \times oceania \\ & + \beta_5 \times mideast + \beta_6 \times latin + \beta_7 \times africa + \beta_8 \times epi + \beta_9 \times stock \\ & + \beta_{10} \times fsc + \beta_{11} \times oneworld + \beta_{12} \times skyteam + \beta_{13} \times star_{alliance} \\ & + \beta_{14} \times gdp_{nominal} + \beta_{15} \times gdp_{ppp} + \beta_0 + \mu_0 \end{aligned}$$

After several arounds of testing and tuning, the final formula is as following:

$$\begin{aligned} & sqrt(env_{score}) \\ & = \beta_1 \times rpk + \beta_2 \times northamerica + \beta_3 \times asia + \beta_4 \times oceania \\ & + \beta_5 \times mideast + \beta_6 \times latin + \beta_7 \times africa + \beta_8 \times epi + \beta_9 \times stock \\ & + \beta_{10} \times fsc + \beta_{11} \times oneworld + \beta_{12} \times skyteam + \beta_{13} \times star\_alliance \\ & + \beta_{14} \times gdp_{nominal} + \beta_{15} \times gdp_{ppp} + \beta_0 + \mu_0 \end{aligned}$$

Two multiple linear regressions were calculated to see the changes of environmental reporting performance scores based on revenue passenger kilometers (RPK), locations of airlines' headquarters, environmental performance index (EPI), listing status, business model,

alliance status and gross domestic product (GDP) of their mother countries. The whole process can be found in Appendix C. A significant regression equation was found (F (15, 83) = 6.541, p < .000), with an R^2 of 0.5417 and adjusted $R^2 = 0.4589$. The root square of participants' predicted environmental reporting score is equal to $4.676 \times 10^{-5} \times rpk + 0.3268 \times northamerica + 4.137 \times asia - 4.386 \times oceania - 1.535 \times 10^{-1} \times mideast + 7.243 \times latin - 3.116 \times africa + 0.4037 \times epi + 8.604 \times stock - 2.896 \times fsc + 6.152 \times oneworld + 3.803 \times skyteam + 7.381 \times star\_alliance - 1.902 \times 10^{-4} \times gdp\_nominal + 2.306 \times 10^{-4} \times gdp\_ppp - 26.41$, where rpk, gdps are measured in US$millions, and northamerica, asia, oceania, mideast, latin and africa are a set of dummy variables, oneworld, skyteam and star_alliance are a set of dummy variables, epi is a score based on a series of calculation and stock and fsc are two dummy variables as well.

And in the second regression equation, the (F (15, 83) = 7.583, p < .000), with an R^2 of 0.5781 and adjusted $R^2 = 0.5019$. The root square of participants' predicted environmental reporting score is equal to $9.612 \times 10^{-6} \times rpk - 0.6847 \times northamerica + 0.2791 \times asia - 0.3629 \times oceania - 6.159 \times 10^{-2} \times mideast + 0.9884 \times latin - 0.7163 \times africa + 6.689 \times 10^{-2} \times epi + 1.741 \times stock - 0.2606 \times fsc + 0.5479 \times oneworld + 0.3462 \times skyteam + 1.186 \times star\_alliance - 2.385 \times 10^{-5} \times gdp\_nominal + 2.747 \times 10^{-5} \times gdp\_ppp - 3.699$. The measurement here in this equation is the same as the previous one. Since the adjusted R^2 goes higher while R^2 goes lower, it can be concluded that this equation explains the differences of dependent variable better.

It goes without saying that it seems unreasonable to drop those variables, like business models and GDP related variables, because the purpose of this thesis is to test them. However, in the first round of testing, their relationships have already shown clearly in the regression result.

The reason for the following testing and regression model tuning is trying to present a more accurate relationship between significant independent variables and the dependent variable and see if those rest of independent variables can give a more accurate explanation to the difference in the dependant variable. As the result shown, RPK is highly significant throughout the optimizing process and consistently exhibits a positive correlation with environmental scores. Therefore, Hypothesis 1 is supported.

In terms of regional differences, regions do not present any significance. Therefore Hypothesis 2 cannot be supported. But EPI reflects a positive significant throughout the process. From this, the location of the airline's headquarters does have an impact on the performance of the airline's environmental sustainability report. However, the reason why such a strong significance is not reflected in regional difference may be because the division of regions is too general. But the reason behind this still needs to be checked closely because, intuitively, the regional culture has an impact on a region's perception of an issue.

At the same time, it can be found in the process of optimization that GDP has produced multiple collinearities for EPI. It can also be seen that GDP has a certain linear relationship with the country's EPI. From the EPI official website, scholars also found this correlation in the newest 2020 data. The Hypothesis 3 and 4 are supported here. The reason may be similar to the H_1. In countries with economic advantages, there will be more resources to invest in environmental issues. But the specific content has yet to be verified.

Listed airlines do have a better performance in environmental sustainability reporting, which means Hypothesis 5 is supported. As mentioned earlier, there are many motivations for listed companies to do so. For the listed company itself, to be able to provide more transparent information to shareholders, a well-prepared sustainability report can be a good choice. This not

only provides information to current shareholders, but also establishes a responsible image and attracts more investors to invest in.

In terms of aviation alliances, the independent variable star_alliance is significant from beginning to end. But the other two aviation alliances' variables do not show any level of significance. It can, therefore, be concluded that whether to join an alliance has no impact on the environmental sustainability reporting performance. It is worth noting that Star Alliance is an exception among those three, which means members in Star Alliance did do a better job than other airlines which no matter are in other alliance or not in any of alliance.

Last but not the least, for the business model, it does not show any significance in the result. This goes against the previous conclusions because in general a full-service carrier is more likely to have a larger company size than a low-cost carrier has. It comes with the last statement that they seem to have more resources and more approaches to monitor and achieve a sustainable development, and, of cause, are much more willing to and easier for them to improve their environmental sustainability reporting performance. Although, by observing the data, a low-cost carrier is more likely to be a lower-RPK airlines than a full-service carrier is, the distribution of these two is relatively balanced, which means a high-RPK airline can be a low-cost carrier while a low-RPK airline is operating as a full-service carrier. Therefore, taking this into account, previous conclusions of larger airlines that have better performance in reporting is still supported.

Chapter 8 Discussion

Revenue passenger kilometers (RPK) shows the number of kilometers traveled by paying passengers, and it is usually an airline traffic statistic. Revenue passenger kilometers are calculated by multiplying the number of paying passengers by the travel distance. The airline's traffic statistics will help the airline formulate a forward business strategy to attract passengers in a highly competitive market. As an airline with a relative higher RPK can achieve higher profitability than an airline with a lower RPK. Meanwhile, low profit margins and high costs may plague the aviation industry which means that most efforts to maintain the aviation industry sustainability are driven by the desire for cost-effectiveness. With the advance of new aircraft (such as Boeing 787 Dreamliner, A380), the fuel consumption of a latest aircraft can be reduced up to 20% compared with an old aircraft (IATA, 2020). The newer fleets can not only save aviation fuel, but also require less power for lights, better air filtration systems and generally better use of the space. Based on the incentive to lower the cost and increase the profit margin, airlines will be glad to upgrade their fleets once they can find an outlet for their old fleets.

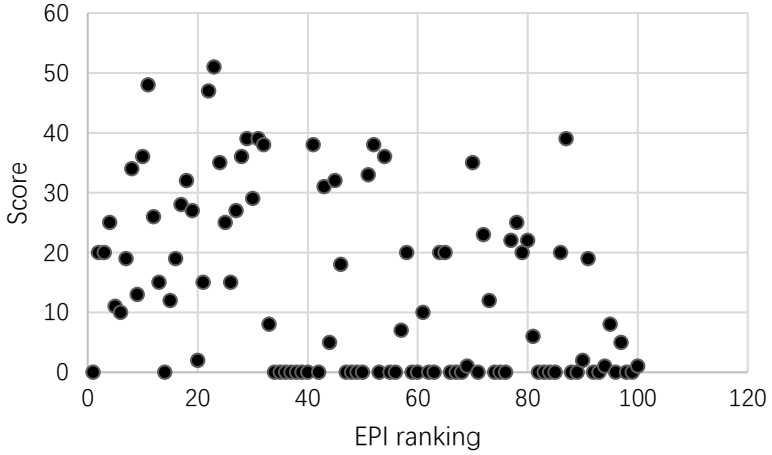
On the other side, although the topic of biofuels is not without controversy, it is exciting to see that the aviation industry is taking steps to move away from traditional petroleum fuel, and three airlines are already using biofuels as a part of their aviation fuel in commercial flights. KLM is a leading airline in innovations in this field and is the airline that uses biofuels for the longest flight tests. There is no doubt that this is cost-driven, and if biofuels can be produced sustainably, then this is a very positive step for the industry. Disappointingly, Emirates has taken almost no action in fuel innovation, further reiterating the role of cost in this process.

An interesting result can be noticed from the regression is that regional factors' null hypothesis cannot be rejected. On the other words, if airline headquarters are grouped according

to their regions (continental level), there is no evidence showing that airline headquarters in a certain continent are having a better environmental sustainability reporting performance than other airlines in other continents. However, the EPI, which is calculated by countries, are showing high significance level to this reporting performance. Therefore, it can be found that if airline headquarters are grouped by countries, there are a certain group of airlines are doing better than others.

As it is defined by several researchers, culture is the beliefs and values that are broadly shared in a specific society at a specific point of time (Ralston et al., 1993), as shared behavior patterns (Mead et al., 1973) and a collective programming of the mindset that distinguishes one group of people from another (Hofstede, 2001). Meanwhile, when we look back at those data (Figure 6), it can be noticed that with the EPI ranking goes behind, the variation of score is smaller and approaching to a lower level.

Figure 6 *Environmental Sustainability Reporting Performance Score by EPI*

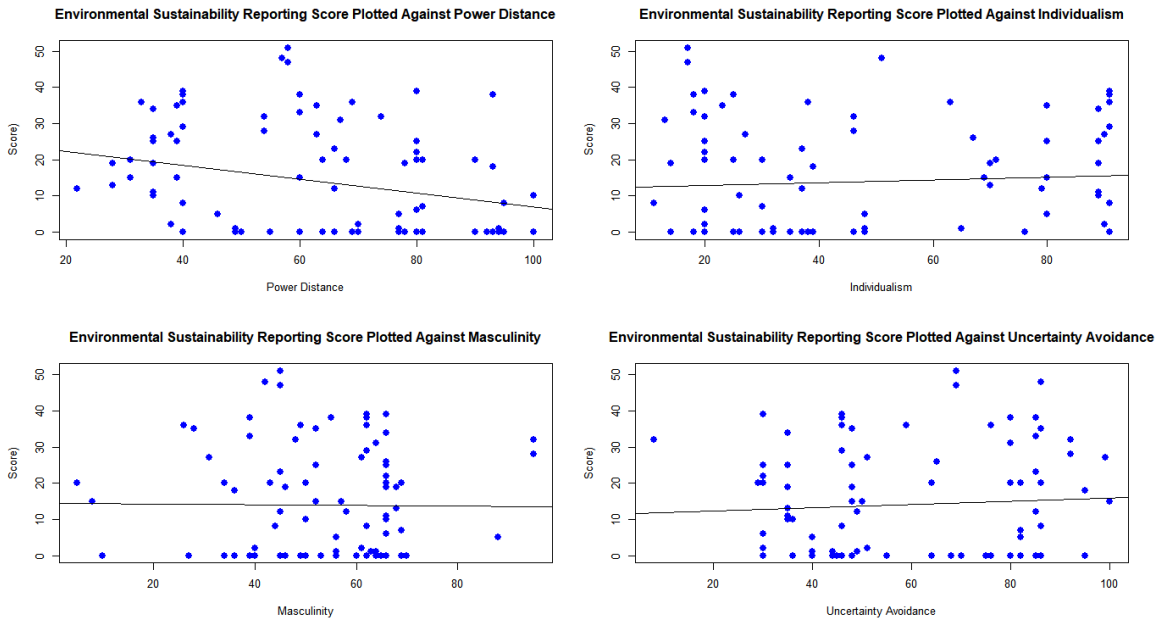


In the map shown in Figure 7, the darker the country is, the higher EPI they have. According to the previous national cultural value researches, countries which have low power distance, low individualism, low masculinity and focus on long-term benefits are more likely hold stronger beliefs about the importance of sustainability (Tata & Prasad, 2015). When the

environmental reporting performance scores are averaged by countries and are compared to those factors mentioned in Tata & Prasad (2015), it does shown the same result as the one in their research conclusion.

Figure 7 *The EPI Ranking Map for Headquarters in the Dataset*

Figure 8 *National Cultural Values vs. Environmental Reporting Performance Score*



It is shown in the Figure 8 that countries low in power distance, individualism, masculinity and high in long-term orientations are more likely to have a higher environmental reporting

performance scores in its aviation industry. That can be one of the reasons why EPI shows a significant result in the regression, but regions separated by markets are not.

As for the stock market, it is desperate for investors to gain as much information about the company they invested in as possible. That information could be their basis of investment decision. Previous researches are mainly focus on the relationship between Stock Price Crash Risk (SPCR) and sustainability reports (Carnevale & Mazzuca, 2014; Harmadji et al., 2020). Stand-alone sustainability reports with effective strategy, high quality and excellent practice can negatively affect SPCR (Harmadji et al., 2020). The disclosure of sustainability reports produces a positive effects on stock price (Carnevale & Mazzuca, 2014). Here in this research, it can be observed that if a target airline is a listed company, no matter which stock market it is at, it will have a relatively higher environmental sustainability reporting performance.

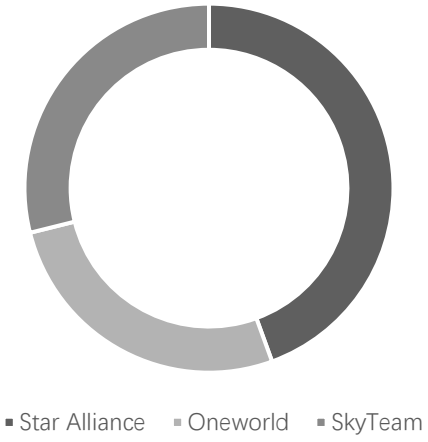
Table 3 *Numbers of Listed and Unlisted Airlines with and without Environmental Sustainability Reports*

	Listed airlines	Unlisted airlines	Total
Disclosed environmental sustainability reports	34	26	60
Undisclosed environmental sustainability reports	6	33	39
Total	40	59	99

As it is noticed in the dataset, 34% of listed airlines disclosed their environmental sustainability reports while 33% of unlisted airlines did not disclose their reports. Comparing to unlisted airlines, only 15% of listed airlines did not disclose their environmental sustainability reports when 55% of unlisted airlines did not do that. When it comes to the precedence, in the listed 40 airlines from the database, 33 of them released their first sustainability report after their

time to market. 6 of them had sustainability reports before their time to market. 4 of them got their sustainability report at the same year of time to market while 10 had not been having their sustainability report since their time to market. Although it could be because the sustainability report is a relatively fresher concept than being listed in the market, the reality is most of airlines discloses their sustainability reports after being public listed. Being listed could be the reason for airlines to prepare for their sustainability reports because that would provide information to shareholders to make information based investing decisions about the efficiency and impact of sustainability decisions and actions and provide a signal of transparency and enhance the reputation and social profile (Deegan, 2004; Deegan et al., 2006; Simnett et al., 2009). Meanwhile, the market could provide airlines positive motivations to invest more resources in reporting performance, which could lead the company to gain a higher market capital. Besides the reporting performance itself, these motivations also could enhance the governance and other aspects in the company making the company a more competitive candidate in the industry.

Figure 9 *The Numbers of Alliance Members in Dataset*



From Figure 9, there are 20 out of 26 Star Alliance members, 12 out of 13 Oneworld members and 13 out of 19 SkyTeam included in the dataset. From the dataset, leading by Star Alliance members, 85% of members in the dataset published their sustainability report, while

67% of Oneworld members and 69% of SkyTeam members published theirs. However, when looking at the aspect of reporting performance scores they received, the average scores receive by Star Alliance members (excluded no-report members) (24.53) is lower than the average scores received by Oneworld members (excluded no-report members) (33.5) and SkyTeam members (excluded no-report members) (28.3). This result is showing that the Star Alliance is winning because the percentage of members who published sustainability reports is more than other two. But by talking about environmental reporting performance, members from SkyTeam are performing in a leading position in the comparison among those three. Regarding the geographical distribution of the members, there is no particular aspect that needs to be mentioned.

Chapter 9 Conclusion

As a conclusion, higher revenue passenger kilometers give airlines much more resources to approach a sustainable development which will lead to a cost-efficiency future. This will increase the profitability with lower cost. A sustainability endeavour gives capital-qualified companies a huge advance to dig out more profits. Larger airlines have better performance in environmental sustainability reporting. On one hand it may be because it has more resources to support such reporting activities. There could be many potential reasons behind this. This can be an interesting topic and angel to examine it. Meanwhile, sustainability reports can give potential investors and shareholders a much clearer view and more confidence in the future profitability of this company, which makes airlines more willing to release more detailed and continuous information in their sustainability-related reports.

Other than these reasons and factors which are as the starting point of a company itself, local governments and airline alliances are playing a big role to urge airlines to disclosure more detailed and more comprehensive information to their stakeholders. It can be boldly suggested that governments or any other regulators are able to have the power and influence in supervising these airlines to have more sustainable operating processes and results. Airlines may be affected by their interests or pressure from these organizations because eventually staying competitive and generating more profits are the core for a for-profit organisation to exist.

Recently in Wellington, New Zealand, there is a supermarket where all items are free. At the same time, many countries in the world are also discussing and experimenting on implementation of a minimum monthly subsidy policy for citizens. Sustainability development is the common goal of the whole mankind. Hope these good wishes will inspire and support airlines to make well-being their top goal.

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Appendix A

Table 4 *Airline Sustainability Reporting Performance Scores*

Airline/Group	Country	Reporting Performance Scores
American Airlines Group	USA	36
Delta Air Lines Group	USA	39
United Continental	USA	29
Emirates Airline	UAE	20
Lufthansa Group	Germany	26
IAG	UK	25
Air France-KLM	France	20
China Southern Airlines	China	22
Southwest Airlines	USA	39
Air China Group	China	25
China Eastern Airlines	China	20
Ryanair	Ireland	13
Qatar Airways	Qatar	38
Air Canada Group	Canada	35
Turkish Airlines	Turkey	23
Aeroflot Group	Russia	18
Singapore Airlines	Singapore	32
Cathay Pacific Group	Hong Kong	39
Hainan Airlines Group	China	22
Qantas Group	Australia	27
LATAM Airlines Group	Chile	35
Etihad Airways	UAE	20
EasyJet	UK	11
ANA Holdings	Japan	28
Alaska Air Group	USA	38
Korean Air	South Korea	33
JetBlue Airways	USA	8
Thai Airways International	Thailand	20
Japan Airlines Group	Japan	32
Norwegian	Norway	15
Saudia	Saudi Arabia	0
Thomas Cook Group	UK	10
IndiGo	India	5
AirAsia Group	Malaysia	10
Wizz Air	Hungary	5
Jet Airways	India	0
Garuda Indonesia	Indonesia	19
EVA Air	Taiwan	47

Table continues

Airline/Group	Country	Reporting Performance Scores
SkyWest Inc	USA	0
Air India	India	0
Asiana Airlines	South Korea	38
Lion Group	Indonesia	0
Sichuan Airlines	China	6
WestJet	Canada	25
Avianca	Colombia	31
China Airlines	China	51
SAS	Sweden	20
Grupo Aeromexico	Mexico	7
Spirit Airlines	USA	0
Virgin Australia Holdings	Australia	2
Gol	Brazil	36
TUI Airways	UK	19
Philippine Airlines	Philippine	0
Virgin Atlantic Airways	UK	34
Alitalia	Italy	0
Ethiopian Airlines	Ethiopia	0
Air New Zealand	New Zealand	12
TAP Air Portugal	Portugal	27
Vietnam Airlines	Vietnam	0
Shandong Airlines	China	0
Malaysia Airlines	Malaysia	0
Copa Airlines	Panama	8
Finnair	Finland	36
Frontier Airlines	USA	0
Spring Airlines	China	0
S7 Airlines Group	Russia	0
Pegasus	Turkey	12
Juneyao Airlines	China	0
Hawaiian Airlines	USA	0
Capital Airlines	China	0
Volaris	Mexico	20
Air Europa	Spain	48
AirAsia X	Malaysia	0
El Al	Israel	19
Oman Air	Oman	0
Cebu Pacific Air	Philippines	1
Azul	Brazil	0
Jet2	UK	0
Aerolineas Argentinas	Argentina	0

Table continues

Airline/Group	Country	Reporting Performance Scores
Flydubai	UAE	0
Vietjet	Vietnam	2
Thai AirAsia	Thailand	0
Air Transat	Canada	15
Ural Airlines	Russia	0
South African Airways	South Africa	1
Egyptair	Egypt	0
Azur Air	Russia	0
Allegiant Air	USA	0
SpiceJet	India	1
Air Arabia	UAE	0
Republic Airline	USA	0
Royal Air Maroc	Morocco	0
SriLankan Airlines	Sri Lanka	0
Interjet	Mexico	0
Jeju Air	South Korean	0
Pakistan Int'l Airlines	Pakistan	0
Aegean Airlines	Greece	15
SunExpress	Turkey	0
Ukraine International	Ukraine	0

Appendix B

Table 5 *GRI Guideline Mapping*

G4 Disclosure	GRI Standard Number	GRI Standard Title	Disclosure Number	Disclosure Title
G4-EN1	GRI 301	Materials	301-1	Materials used by weight or volume
G4-EN2	GRI 301	Materials	301-2	Recycled input materials used
G4-EN3	GRI 302	Energy	302-1	Energy consumption within the organization
G4-EN4	GRI 302	Energy	302-2	Energy consumption outside the organization
G4-EN5	GRI 302	Energy	302-3	Energy intensity
G4-EN6	GRI 302	Energy	302-4	Reduction of energy consumption
G4-EN7	GRI 302	Energy	302-5	Reduction in energy requirements of products and services
G4-EN8	GRI 303	Water	303-1	Water withdrawal by source
G4-EN9	GRI 303	Water	303-2	Water sources significantly affected by withdrawal of water
G4-EN10	GRI 303	Water	303-3	Water recycled and reused
G4-EN11	GRI 304	Biodiversity	304-1	Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas
G4-EN12	GRI 304	Biodiversity	304-2	Significant impacts of activities, products, and services on biodiversity
G4-EN13	GRI 304	Biodiversity	304-3	Habitats protected or restored
G4-EN14	GRI 304	Biodiversity	304-4	IUCN Red List species and national conservation list species with habitats in areas affected by operations
G4-EN15	GRI 305	Emissions	305-1	Direct (Scope 1) GHG emissions
G4-EN16	GRI 305	Emissions	305-2	Energy indirect (Scope 2) GHG emissions
G4-EN17	GRI 305	Emissions	305-3	Other indirect (Scope 3) GHG emissions
G4-EN18	GRI 305	Emissions	305-4	GHG emissions intensity

Table continues

G4 Disclosure	GRI Standard Number	GRI Standard Title	Disclosure Number	Disclosure Title
G4-EN19	GRI 305	Emissions	305-5	Reduction of the GHG emissions
G4-EN20	GRI 305	Emissions	305-6	Emissions of ozone-depleting substances (ODS)
G4-EN21	GRI 305	Emissions	305-7	Nitrogen oxides (NOx) sulfur oxides (SOx), and other significant air emissions
G4-EN22	GRI 306	Effluents and Waste	306-1	Water discharge by quality and destination
G4-EN23	GRI 306	Effluents and Waste	306-2	Waste by type and disposal method
G4-EN24	GRI 306	Effluents and Waste	306-3	Significant spills
G4-EN25	GRI 306	Effluents and Waste	306-4	Transport of hazardous waste
G4-EN26	GRI 306	Effluents and Waste	306-5	Water bodies affected by water discharges and/or runoff
G4-EN27	NA	N/A	N/A	N/A
G4-EN28	GRI 301	Materials	301-3	Reclaimed products and their packaging materials
G4-EN29	GRI 307	Environmental Compliance	307-1	Non-compliance with environmental laws and regulations
G4-EN30	NA	N/A	N/A	N/A

Table continues

G4 Disclosure	GRI Standard Number	GRI Standard Title	Disclosure Number	Disclosure Title
G4-EN31	Several	Several	N/A	N/A
G4-EN32	GRI 308	Supplier Environmental Assessment	308-1	New suppliers that were screened using environmental criteria
G4-EN33	GRI 308	Supplier Environmental Assessment	308-2	Negative environmental impacts in the supply chain and actions taken
G4-EN34	GRI 103	Management Approach	103-2	The management approach and its components

Appendix C

Table 6 *5 Detailed Examples of Environmental Sustainability Reporting Performance Score*

G4 Disclosure	Disclosure Number	American Airlines Group	Delta Air Lines Group	United Continental	Emirates Airline	Lufthansa Group
EN-1	301-1	0	0	0	0	0
EN-2	301-2	0	0	0	0	0
EN-3	302-1	3	3	2	3	3
EN-4	302-2	0	1	3	0	0
EN-5	302-3	3	3	2	3	1
EN-6	302-4	1	1	3	0	2
EN-7	302-5	1	1	2	0	2
EN-8	303-1	3	0	0	0	0
EN-9	303-2	0	0	0	0	0
EN-10	303-3	0	0	0	0	0
	303-4	0	0		0	0
	303-5	0	0		0	0
EN-11	304-1	0	0	0	0	0
EN-12	304-2	0	0	0	0	0
EN-13	304-3	0	0	0	2	0
EN-14	304-4	0	0	0	0	0
EN-15	305-1	3	3	0	3	3
EN-16	305-2	3	3	3	3	3
EN-17	305-3	3	3	3	0	3
EN-18	305-4	3	1	3	3	2
EN-19	305-5	1	1	0	0	2
EN-20	305-6	3	3	2	0	0
EN-21	305-7	3	3	0	3	0
EN-22	306-1	0	1	0	0	0
EN-23	306-2	3	3	3	0	0
EN-24	306-3	0	3	0	0	0
EN-25	306-4	0	1	0	0	0
EN-26	306-5	0	1	3	0	0
EN-27				0		
EN-28	301-3	0	0	0	0	0
EN-29	307-1	3	1	0	0	0
EN-30				0		
EN-31				0		
EN-32	308-1	0	0	0	0	2
EN-33	308-2	0	0	0	0	0

G4 Disclosure	Disclosure Number	American Airlines Group	Delta Air Lines Group	United Continental	Emirates Airline	Lufthansa Group
EN-34	103-2			0		
	103-1	0	1		0	1
	103-2	0	1		0	1
	103-3	0	1		0	1
Total		36	39	29	20	26

Appendix D

Table 7 *5 Detailed Examples of Independent Variables Dataset*

	American Airlines Group	Delta Air Lines Group	United Continental	Emirates Airline	Lufthansa Group
rpk	364191	350299	347963	292221	261156
env_score	36	39	29	20	26
hq_country	United States	United States	United States	United Arab Emirates	Germany
northamerica	1	1	1	0	0
asia	0	0	0	0	0
oceania	0	0	0	0	0
mideast	0	0	0	1	0
latin	0	0	0	0	0
africa	0	0	0	0	0
europe	0	0	0	0	1
epi_ranking	27	27	27	77	13
epi	71.19	71.19	71.19	58.9	78.37
stock	1	1	1	0	0
founded	2013	1924	2010	1985	1953
fsc	1	1	1	1	1
oneworld	1	0	0	0	0
skyteam	0	1	0	0	0
star_alliance	0	0	1	0	1
gdp_nominal	59501	59501	59501	37226	44550
gdp_ppp	59501	59501	59501	67741	50425

Appendix E

Regression Model Testing by RStudio

In the initial linear regression, all dummy variables (region, business model, alliance) are included in the model to test if there is any mistake made in the data about those variables which should have perfect collinearity among them. And as the result shown below, Europe, lcc(low cost carrier), and no_alliance are not defined because of singularities, which means data of locations of airlines' headquarters, business model and alliance status are perfectly collinear.

Formula:

$$\begin{aligned} env\_score = {} & \beta_1 \times rpk + \beta_2 \times northamerica + \beta_3 \times asia + \beta_4 \times oceania \\ & + \beta_5 \times mideast + \beta_6 \times latin + \beta_7 \times africa + \beta_8 \times europe + \beta_9 \times epi \\ & + \beta_{10} \times stock + \beta_{11} \times fsc + \beta_{12} \times lcc + \beta_{13} \times oneworld \\ & + \beta_{14} \times skyteam + \beta_{15} \times star\_alliance + \beta_{16} \times no\_alliance \\ & + \beta_{17} \times gdp_{nominal} + \beta_{18} \times gdp_{ppp} + \beta_0 + \mu_0 \end{aligned}$$

Residuals:

Min	1Q	Median	3Q	Max
-15.651	-7.570	-1.181	5.569	34.344

Coefficients: (3 not defined because of singularities)

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-2.641e+01	1.156e+01	-2.284	0.02493	*
rpk	4.676e-05	1.728e-05	2.706	0.00826	**
northamerica	3.268e-01	4.765e+00	0.069	0.94549	
asia	4.137e+00	4.809e+00	0.860	0.39214	
oceania	-4.386e+00	7.430e+00	-0.590	0.55659	
mideast	-1.535e-01	6.034e+00	-0.025	0.97977	
latin	7.243e+00	5.443e+00	1.331	0.18696	.
africa	-3.116e+00	8.342e+00	-0.374	0.70966	
europe	NA	NA	NA	NA	
epi	4.037e-01	1.732e-01	2.331	0.02217	*
stock	8.604e+00	2.642e+00	3.256	0.00164	**
fsc	-2.896e+00	3.119e+00	-0.928	0.35589	
lcc	NA	NA	NA	NA	

oneworld	6.152e+00	4.316e+00	1.425	0.15779	
skyteam	3.803e+00	4.084e+00	0.931	0.35488	
star_alliance	7.381e+00	3.619e+00	2.040	0.04458	*
no_alliance	NA	NA	NA	NA	
gdp_nominal	-1.902e-04	2.209e-04	-0.861	0.39176	
gdp_ppp	2.306e-04	1.628e-04	1.417	0.16034	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

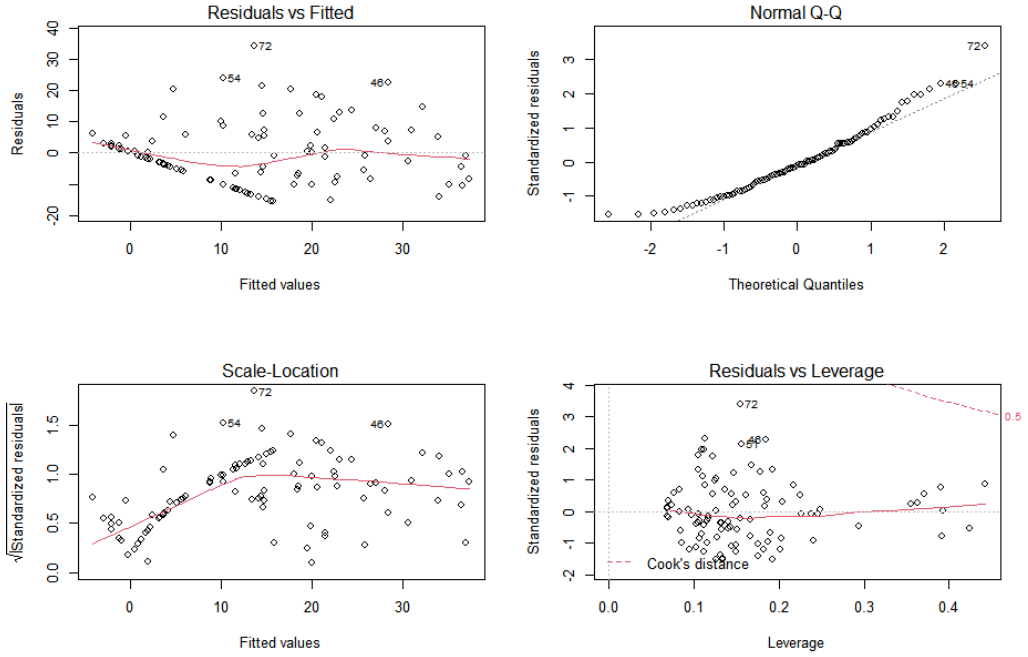
Residual standard error: 10.95 on 83 degrees of freedom

Multiple R-squared: 0.5417, Adjusted R-squared: 0.4589

F-statistic: 6.541 on 15 and 83 DF, p-value: 5.646e-09

As shown in the upper right corner of the figure 10, most of the points in the graph fall on a straight line at a 45-degree angle, which means it meets the assumption of normality. The Residual vs Fitted graph is shown on the top left corner of the figure 9, where curvilinear relationship exists but not obvious. For the independence of dependent variables, there is no priori reason to believe that there is a relationship between an airline's environmental sustainability reporting performance score and another airline's score. Some of those airlines may come from a same alliance, but they are still independent company on operational level. Therefore, it is reasonable to believe that those reports are written and finished independently. Subsequently, homoskedasticity will be tested.

Figure 10 *Diagnostic Plots of Regression*



By using the ncvTest() function, a scoring test is generated. The null hypothesis is that the error variance is constant, and the alternative hypothesis is that the error variance changes with the level of the fitted value. The p-value provide by this function is 0.05839, which rejects the null hypothesis and means the heteroscedasticity is indeed present. Based on this result, we use the spreadLevelPlot() function to get the suggested power transformation which is 0.4573776. Because this number is close to 0.5, square-rooted environmental score is used instead of the original dependent variable.

Formula:

$$sqrt(env_{score}) = \beta_1 \times rpk + \beta_2 \times northamerica + \beta_3 \times asia + \beta_4 \times oceania + \beta_5 \times mideast + \beta_6 \times latin + \beta_7 \times africa + \beta_8 \times epi + \beta_9 \times stock + \beta_{10} \times fsc + \beta_{11} \times oneworld + \beta_{12} \times skyteam + \beta_{13} \times star\_alliance + \beta_{14} \times gdp_{nominal} + \beta_{15} \times gdp_{ppp} + \beta_0 + \mu_0$$

Residuals:

Min	1Q	Median	3Q	Max
-2.809	-1.079	-0.331	1.122	4.418

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-3.699e+00	1.869e+00	-1.979	0.051075	.
rpk	9.612e-06	2.792e-06	3.442	0.000906	***
northamerica	-6.847e-01	7.700e-01	-0.889	0.376457	
asia	2.791e-01	7.771e-01	0.359	0.720434	
oceania	-3.629e-01	1.201e+00	-0.302	0.763218	
mideast	-6.159e-02	9.751e-01	-0.063	0.949792	
latin	9.884e-01	8.796e-01	1.124	0.264386	
africa	-7.163e-01	1.348e+00	-0.531	0.596542	
epi	6.689e-02	2.798e-02	2.391	0.019078	*
stock	1.741e+00	4.270e-01	4.078	0.000104	***
fsc	-2.606e-01	5.041e-01	-0.517	0.606554	
oneworld	5.479e-01	6.974e-01	0.786	0.434307	
skyteam	3.462e-01	6.599e-01	0.525	0.601290	
star_alliance	1.186e+00	5.848e-01	2.027	0.045842	*
gdp_nominal	-2.385e-05	3.570e-05	-0.668	0.505862	
gdp_ppp	2.747e-05	2.631e-05	1.044	0.299420	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.769 on 83 degrees of freedom

Multiple R-squared: 0.5781, Adjusted R-squared: 0.5019

F-statistic: 7.583 on 15 and 83 DF, p-value: 2.724e-10

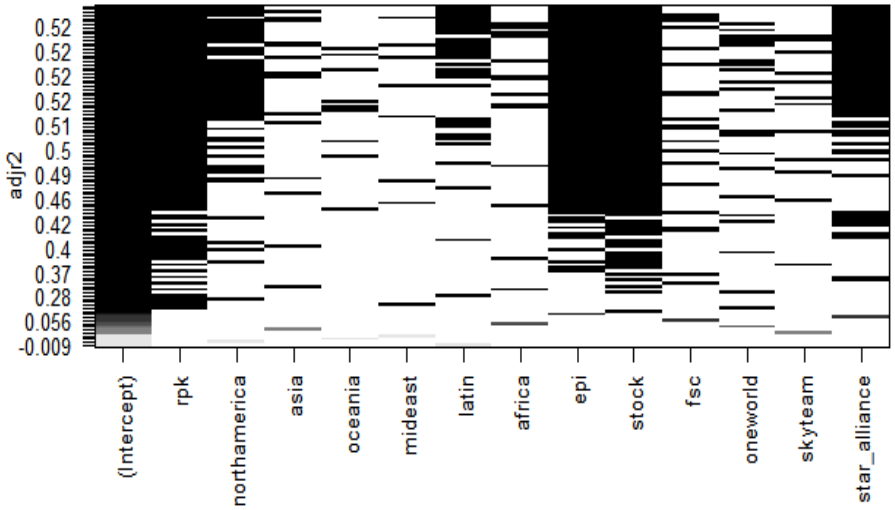
Once again, the regression model was tested for homoscedasticity, and the p value is 0.86999. Therefore, the null hypothesis is accepted. Heteroscedasticity has been eliminated by introducing the square-rooted environmental score as the dependent variable.

The next step is to diagnose the multicollinearity. Based on the priori information, GPD, EPI and the locations of headquarters could be related. Multicollinearity is tested using the variance inflation factor (VIF) in this research. After many tests and adjustments, the variables about GDP were removed from the model. And after the removal, the p value of EPI reduces

from 0.02217 to 0.0019078. This is a proof of previous assumptions about the correlated relationship between GDP variables and the EPI.

Consequently, the optimal model is obtained by best subsets regression. Adjusted R is used as a basis for judging the degree of fit.

Figure 11 *Adjusted R for Subsets Regression*



As can be seen from the figure 11, the business model can be excluded from the model for a better fitness.

Appendix E

RStudio Code

```
fit <- lm(env_score ~ rpk + northamerica + asia + oceania + mideast + latin + africa + epi + stock + fsc + oneworld + skyteam + star_alliance + gdp_nominal + gdp_ppp, data=Clean)
par(mfrow=c (2,2))
plot(fit)
summary(fit)
Call:
lm(formula = env_score ~ rpk + northamerica + asia + oceania +
    mideast + latin + africa + epi + stock + fsc + oneworld +
    skyteam + star_alliance + gdp_nominal + gdp_ppp, data = Clean)

Residuals:
     Min       1Q   Median       3Q      Max
-15.651   -7.570   -1.181    5.569   34.344

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)     -2.641e+01  1.156e+01   -2.284  0.02493 *
rpk              4.676e-05  1.728e-05    2.706  0.00826 **
northamerica     3.268e-01  4.765e+00    0.069  0.94549
asia             4.137e+00  4.809e+00    0.860  0.39214
oceania         -4.386e+00  7.430e+00   -0.590  0.55659
mideast         -1.535e-01  6.034e+00   -0.025  0.97977
latin            7.243e+00  5.443e+00    1.331  0.18696
africa          -3.116e+00  8.342e+00   -0.374  0.70966
epi              4.037e-01  1.732e-01    2.331  0.02217 *
stock            8.604e+00  2.642e+00    3.256  0.00164 **
fsc             -2.896e+00  3.119e+00   -0.928  0.35589
oneworld         6.152e+00  4.316e+00    1.425  0.15779
```

```
skyteam              3.803e+00    4.084e+00      0.931    0.35448
star_alliance    7.381e+00    3.619e+00      2.040    0.04458 *
gdp_nominal      -1.902e-04    2.209e-04    -0.861    0.39176
gdp_ppp              2.306e-04    1.628e-04      1.417    0.16034
---
Signif. codes:    0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 10.95 on 83 degrees of freedom
Multiple R-squared:    0.5417,       Adjusted R-squared:    0.4589
F-statistic: 6.541 on 15 and 83 DF,    p-value: 5.646e-09

library(car)
ncvTest(fit)
Non-constant Variance Score Test
Variance formula: ~ fitted.values
Chisquare = 3.582538, Df = 1, p = 0.05839

spreadLevelPlot(fit)
Suggested power transformation:    0.4573776

fit <- lm(sqrt(env_score) ~ rpk + northamerica + asia + oceania + mideast + latin + africa +
epi + stock + fsc + oneworld + skyteam + star_alliance + gdp_nominal + gdp_ppp, data=Clean)
par(mfrow=c(2,2))
plot(fit)
summary(fit)

Call:
lm(formula = sqrt(env_score) ~ rpk + northamerica + asia + oceania +
      mideast + latin + africa + epi + stock + fsc + oneworld +
      skyteam + star_alliance + gdp_nominal + gdp_ppp, data = Clean)
```

Residuals:

Min	1Q	Median	3Q	Max
-2.809	-1.079	-0.331	1.122	4.418

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-3.699e+00	1.869e+00	-1.979	0.051075	.
rpk	9.612e-06	2.792e-06	3.442	0.000906	***
northamerica	-6.847e-01	7.700e-01	-0.889	0.376457	
asia	2.791e-01	7.771e-01	0.359	0.720434	
oceania	-3.629e-01	1.201e+00	-0.302	0.763218	
mideast	-6.159e-02	9.751e-01	-0.063	0.949792	
latin	9.884e-01	8.796e-01	1.124	0.264386	
africa	-7.163e-01	1.348e+00	-0.531	0.596542	
epi	6.689e-02	2.798e-02	2.391	0.019078	*
stock	1.741e+00	4.270e-01	4.078	0.000104	***
fsc	-2.606e-01	5.041e-01	-0.517	0.606554	
oneworld	5.479e-01	6.974e-01	0.786	0.434307	
skyteam	3.462e-01	6.599e-01	0.525	0.601290	
star_alliance	1.186e+00	5.848e-01	2.027	0.045842	*
gdp_nominal	-2.385e-05	3.570e-05	-0.668	0.505862	
gdp_ppp	2.747e-05	2.631e-05	1.044	0.299420	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.769 on 83 degrees of freedom

Multiple R-squared: 0.5781, Adjusted R-squared: 0.5019

F-statistic: 7.583 on 15 and 83 DF, p-value: 2.724e-10

ncvTest(fit)

Non-constant Variance Score Test

Variance formula: ~ fitted.values

Chisquare = 0.02678925, Df = 1, p = 0.86999

```
fit <- lm(sqrt(env_score) ~ rpk + northamerica + asia + oceania + mideast + latin + africa + epi + stock + fsc + oneworld + skyteam +star_alliance + gdp_nominal + gdp_ppp, data=Clean)

vif(fit)
          rpk northamerica          asia       oceania
     1.565850     2.541006     4.560780     1.339828
     mideast        latin       africa          epi
     3.203664     2.022598     1.688868     3.783838
       stock          fsc     oneworld      skyteam
     1.434715     1.697566     1.638931     1.571404
star_alliance  gdp_nominal      gdp_ppp
     1.743996    18.647633    10.740433
sqrt(vif(fit)) > 2 # problem?
          rpk northamerica          asia       oceania
        FALSE        FALSE        TRUE         FALSE
     mideast        latin       africa          epi
        FALSE        FALSE        FALSE        FALSE
       stock          fsc     oneworld      skyteam
        FALSE        FALSE        FALSE        FALSE
star_alliance  gdp_nominal      gdp_ppp
        FALSE         TRUE         TRUE

fit <- lm(sqrt(env_score) ~ rpk + northamerica + asia + oceania + mideast + latin + africa + epi + stock + fsc + oneworld + skyteam +star_alliance, data=Clean)
par(mfrow=c(2,2))
plot(fit)
summary(fit)
```

Call:

lm(formula = sqrt(env_score) ~ rpk + northamerica + asia + oceania +
mideast + latin + africa + epi + stock + fsc + oneworld +
skyteam + star_alliance, data = Clean)

Residuals:

Min	1Q	Median	3Q	Max
-2.6622	-1.0566	-0.3486	1.1677	4.4670

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-4.084e+00	1.747e+00	-2.337	0.021783	*
rpk	1.001e-05	2.712e-06	3.691	0.000394	***
northamerica	-7.010e-01	6.410e-01	-1.094	0.277189	
asia	5.351e-01	7.134e-01	0.750	0.455321	
oceania	-5.555e-01	1.122e+00	-0.495	0.621919	
mideast	5.853e-01	7.753e-01	0.755	0.452408	
latin	1.113e+00	8.270e-01	1.346	0.181948	
africa	-6.784e-01	1.334e+00	-0.509	0.612387	
epi	7.507e-02	2.235e-02	3.359	0.001173	**
stock	1.677e+00	4.098e-01	4.092	9.68e-05	***
fsc	-2.147e-01	4.999e-01	-0.429	0.668700	
oneworld	6.351e-01	6.866e-01	0.925	0.357554	
skyteam	4.064e-01	6.448e-01	0.630	0.530187	
star_alliance	1.234e+00	5.760e-01	2.143	0.034980	*

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.761 on 85 degrees of freedom
Multiple R-squared: 0.5717, Adjusted R-squared: 0.5062
F-statistic: 8.727 on 13 and 85 DF, p-value: 5.348e-11

```
library(leaps)
leaps <- regsubsets(sqrt(env_score) ~ rpk + northamerica + asia + oceania + mideast + latin
+ africa + epi + stock + fsc + oneworld + skyteam +star_alliance, data=Clean, nbest=14)
plot(leaps, scale = "adjr2")

fit <- lm(sqrt(env_score) ~ rpk + epi + stock, data=Clean)
summary(fit)

Call:
lm(formula = sqrt(env_score) ~ rpk + epi + stock, data = Clean)

Residuals:
      Min        1Q    Median        3Q       Max
-3.7660 -1.2664 -0.4754  1.3148  4.6684

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.510e+00  9.507e-01  -2.640 0.009692 **
rpk              1.060e-05  2.553e-06   4.151 7.21e-05 ***
epi              5.742e-02  1.529e-02   3.755 0.000299 ***
stock            1.738e+00  4.042e-01   4.300 4.14e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.833 on 95 degrees of freedom
Multiple R-squared:  0.4817,    Adjusted R-squared:  0.4653
F-statistic: 29.43 on 3 and 95 DF,  p-value: 1.525e-13

relweights <- function(fit, ...) {
    R <- cor(fit$model)
```

```
    nvar <- ncol(R)
    rxx <- R[2:nvar, 2:nvar]
    rxy <- R[2:nvar, 1]
    svd <- eigen(rxx)
    evec <- svd$vectors
    ev <- svd$values
    delta <- diag(sqrt(ev))

    lambda <- evec %*% delta %*% t(evec)
    lambdasq <- lambda^2

    beta <- solve(lambda) %*% rxy
    rsquare <- colSums(beta^2)
    rawwgt <- lambdasq %*% beta^2
    import <- (rawwgt/rsquare) * 100
    lbls <- names(fit$model[2:nvar])
    rownames(import) <- lbls
    colnames(import) <- "Weights"

    barplot(t(import), names.arg = lbls, ylab = "% of R-Square",
        xlab = "Predictor Variables", main = "Relative Importance of Predictor Variables",
        sub = paste("R-Square = ", round(rsquare, digits = 3)),
        ...)
    return(import)
}

relweights(fit)
           Weights
rpk      37.83822
epi      24.25740
stock 37.90439
```

fit <- lm(sqrt(env_score) ~ rpk + northamerica + asia + oceania + mideast + latin + africa + epi + stock + fsc + oneworld + skyteam +star_alliance, data=Clean)

relweights(fit)

	Weights
rpk	27.1847935
northamerica	1.2899308
asia	2.2959050
oceania	0.1900119
mideast	0.5285348
latin	1.0562646
africa	3.1049194
epi	18.1469655
stock	29.2471666
fsc	3.9691984
oneworld	2.9487199
skyteam	1.6351423
star_alliance	8.4024472