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THE IMPACT OF LONG-TERM BRAND DEVELOPMENT STRATEGIES ON BRAND VALUE OF COMPANIES OPERATING IN HIGH-TECHNOLOGY MARKETS

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ABSTRACT

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The objective of the current research is to investigate brand value generation. The study is conducted in the context of high-technology companies. The research aims at finding the impact of long-term brand development strategies, including advertising investments, R&D investments, R&D intensity, new products developed and design.

The empirical part of the study incorporated collection of primary and secondary data on 36 companies operating in high-technology sector and being rated as top companies with the most valuable brands by Interbrand consultancy. The data contained information for six consequent years from 2008 to 2013. Obtained data was analyzed using the methods of fixed effect and random effect model (panel data analysis). The analysis showed positive effect of advertising and R&D investments on brand value of high-technology companies in the long run. The impact of remaining three strategies was not approved and further investigation is required.

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Sincerely,
Alena.

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LIST OF SYMBOLS AND ABBREVIATIOS

Adv	Advertising
BRI	Brand Recall Index
BV	Brand value
L1. (L.)	Value lagged by one year
NPD	New product development/ new products developed
R&D (RnD)	Research and development
RnD_int	Research and development intensity
₩	South-Korean won
¥	Japanese yen
€	The euro
$	US dollar

1. INTRODUCTION

An introduction chapter gives an overview of the thesis work. Background information of the research will be presented first, followed by the definitions and concepts used in the study. Secondly, the research problem will be presented, along with the research objectives and delimitations. The chapter continues with the research methodology used, including research framework and type of the research. Finally, the structure of the research will be laid out.

1.1. Background

Today, the companies operating in high-tech sector play an important role in the economy and represent a big share of the world's leading companies. They often possess strong brands, and it is proved by the research done. Thus, for instance the research, done by Interbrand or BrandZ, shows that about 40% of the top global brands belong to high-tech companies (Interbrand, 2013; BrandZ, 2013).

Today's a lot of most valuable brands are owned by companies working with high-technology products or services. And revealing the brand strategies leading to it might be valuable to many companies, operating in high-tech environment and aiming at increasing their brand value.

On the other hand, there seems not much research done in this area. Some part of research was conducted on long-term brand development strategies, like innovations, distribution, and advertising (Heerde, Mela, & Manchanda, 2004; Mela, Ataman, & Heerde, 2006), product-line changes and advertising (Pauwels, 2004), and new product development (Pauwels, Silva-Risso, Srinivasan, & Hanssens, 2004) and their effectiveness on marketing and brand effectiveness. The studies executed previously provide a base for the current work, though they have not covered the whole scope of the researched issue of the present Master's Thesis. Thus,

this work will cover the gap in the existing theory on brand value of high-technology companies.

The ultimate goal of the research is to discover if there is correlation between long-term brand development strategies of high-technology companies and their brands' value. For this research long-term brand development strategies include investments in R&D, R&D intensity, advertising, new product development (NPD), and design.

1.2. Literature review

The previous research has studied the influence of particular antecedents on brand value. Thus, Pauwels (2004) studied the effect of consumer response, competitor response, company support, and company inertia on the long-term marketing effectiveness. Being part of company support, product-line extensions and advertising were found to have an impact on marketing effectiveness. Though, this research did not fully explain if this effect is premeditated and profitable.

Mela, Ataman, and Heerde (2006) studied the long-term effect of marketing mix elements on building brand equity by using five-year weekly data from 70 brands in 184 stores and measuring the effect on sales and elasticity. Their results showed that distribution, product innovations, and advertising play important role in it. Thus, product variety appears to be an important element increasing both quantity and price premiums. Advertising on the other hand plays an important role in increasing quantity premiums. Distribution in terms of breadth provides a big positive long-term effect on margin premium. The full applicability of the research done by Mela, Ataman, and Heerde to the current study is questionable, since the sample used included many non-high-technology items. Nevertheless, the authors provided a useful summary of the research done in terms of the long-term impact of the marketing mix elements. It is presented further in Table 1.

Table 1. Literature on long-term effects of marketing mix elements (Mela, Ataman, Heerde, 2006).

	Effect of				
	Promotion	**Advertising**	**Distribution**	**Product**	**Effect on**
Clarke (1976)		v			Brand Sales
Baghestani (1991)		v			Brand Sales
Dekimpe and Hanssens (1995)		v			Chain Sales
Papatla and Krishnamurthi (1996)	v				Choice
Mela, Gupta, and Lehmann (1997)	v	v			Choice
Mela, Jedidi, and Bowman (1998)	v				Incidence and Quantity
Mela, Gupta, and Jedidi (1998)	v	v			Market Structure
Kopalle, Mela, and Marsh (1999)	v				Brand Sales
Jedidi, Mela, and Gupta (1999)	v	v			Choice and Quantity
Foekens, Leefland, and Wittink (1999)	v				Brand Sales
Dekimpe and Hanssens (1999)	v	v			Brand Sales
Dekimpe, Hanssens, and Silva-Risso (1999)	v				Brand and Cat. Sales
Srinivasan, Leszczyc, and Bass (2000)	v		v		Market Share
Bronnenberg, Mahajan, and Vanhonacker (2000)	v	v	v		Market Share
Nijs et al. (2001)	v				Category Sales
Pauwels, Hanssens, and Siddarth (2002)	v				Incidence, Choice, and Quantity
Srinivasan et al. (2004)	v				Margin and Revenue
Pauwels (2004)	v	v		v	Brand Sales
Van Heerde, Mela, and Manchanda (2004)				v	Market Structure
Pauwels et al. (2004)	v			v	Financial measures
Steenkamp et al. (2005)	v	v			Brand Sales

In 2004 Pauwels et al. studied the role of new products introductions and promotions in the automobile industry on financial performance and value of the company. The former appears to bring a positive effect, while the latter does not. Automobile industry can be considered high-tech environment. Even though it is difficult to define the high-tech industry, based on the amounts spend on new product development, automobile industry can be included in this list. (Hatzichronoglou, 1997)

The research based on Interbrand ranking was done by Singfat Chu and Hean Tat Keh (2006). The authors studied the role of lagged advertising, promotions and R&D initiatives in shaping the brand value. The authors used the data for the period from 1999 to 2005 of 73 brands with between 2 to 6 repeat rankings. The research findings show that R&D expenses bring positive results, but mostly for growing, rather than mature markets. Advertising brings most positive results when the spending range is between $200 million and $4.6 billion. Spending above this level on promotions brings even more substantial effect than R&D.

The results of different studies sound sometimes controversial, though there are some repeating antecedents. So far, none of the research has measured the effect of the long-term brand strategies on the brand value, or brand equity, of top high-technology companies operating in various industries. Previous research papers have studied the effect of several antecedents. Though, the impact of such antecedent as design has not been studied much yet. The present research will fill this gap in the literature.

1.3. Definitions and key concepts

The current sub-chapter presents the main key concepts and definitions, further used in the thesis. The concepts and definitions outlined below are serving as the core of the current research and are closely linked with the theory reviewed and used to build the base for the thesis. The aim of this

sub-chapter is to familiarize the readers with the key theoretical ideas and definitions of the topic. The list of the definitions is presented below.

Long-term brand development strategies

The strategies, that bring lagged results and influence the brand in the distant future. For the purposes of the study the long-term brand strategies will include investments in R&D (measured by R&D expenditures), new product development (measured by the number of patented products), innovation (measured by R&D intensity), advertising (measured by advertising expenditures), and design (measured by the score assigned to each studied brand during the survey conducted). In the current research the effect of these long-term brand development strategies will be measured during the period of 6 years, and their impact on the studied companies' brand value will be measured with the time lag of 6 years.

Short-term brand development strategies

Short-term brand development brand strategies are those, that bring immediate results and the impact of which can be seen shortly after the strategies' implementations. Sales promotions are often ascribed to short-term brand strategies.

High-technology industry

High-technology industries are considered to be highly volatile in nature with a big extent of market, technology, and competition uncertainty. Usually such industries are characterized by high investments in R&D and NPD. Hatzichronoglou (1997) considered aerospace, computers, electronics-communication, and pharmaceuticals as high-technology industries; scientific instruments, motor vehicles, electrical machinery, chemicals, other transport equipment, and non-electrical machinery as medium-high-technology industries. For the current study a high-

technology index has been created for evaluating the Top 100 brands from Interbrand's ranking. High-technology companies have been defined in the current research using the following criteria: their R&D intensity and belonging to a specific industry. All the companies have been assigned the scores based on the above criteria and those with the score of 4 or more have been defined as high-technology companies.

Brand value

Brand value is defined as net discounted cashflow attributable to the brand after paying the cost of capital invested to produce and run the business and the cost of marketing (Kapferer, 2008, 14).

Brand value chain

Brand value chain represents a model of creating brand value, which includes value stages of marketing program investments, customer mindset, brand performance, and shareholder value (Keller & Lehmann, 2003).

Brand performance

The performance of a brand is shown by a way how customers respond to the brand. Brand performance includes the following elements: Price premiums, price elasticity, market share, expansion success, cost structure, and profitability. The first three elements are the key or direct revenue stream, meaning that through them the brand value is created. (Keller & Lehmann, 2003)

1.4. Research problem, objectives and delimitation

The goal of the current research is to find out if there is a linear association between several long-term development strategies,

implemented by high-technology companies and the brand value of these companies. The literature overviewed suggests that particular brand-development strategies can impact the brand value of a company in a long-run, which is one of the main aims of the companies – sustainable growth with the future-oriented mind. Thus, present research will study if this takes place for the world's top high-technology brands. And based on the previous studies and aims of the current research the following research problem can be posed:

What is the effect of long-term brand development strategies on the brand value of high-technology companies?

In order to solve the addressed research question several sub-problem should be answered, including:

1. *What is effect of advertising on brand value of high-technology companies?*
2. *What is effect of R&D expenditure on brand value of high-technology companies?*
3. *What is the effect of R&D intensity, as one of the measures of innovativeness, on brand value of high-technology companies?*
4. *What is the effect of new product development on brand value of high-technology companies?*
5. *What is the effect of design on brand value of high-technology companies?*

By answering each of the sub-questions the main research problem will be solved. The first four sub-questions will be answered by analyzing secondary data available, by utilizing companies' annual reports, Interbrand companies' brand value data from 2008 to 2013, and other possible sources. The fifth sub-question will be responded by looking at and analyzing primary data collected during the survey and using the data from Interbrand's ranking for the years from 2008 to 2013.

1.5. Research framework

The theoretical framework for the study to be done is presented in the Figure 1 below.

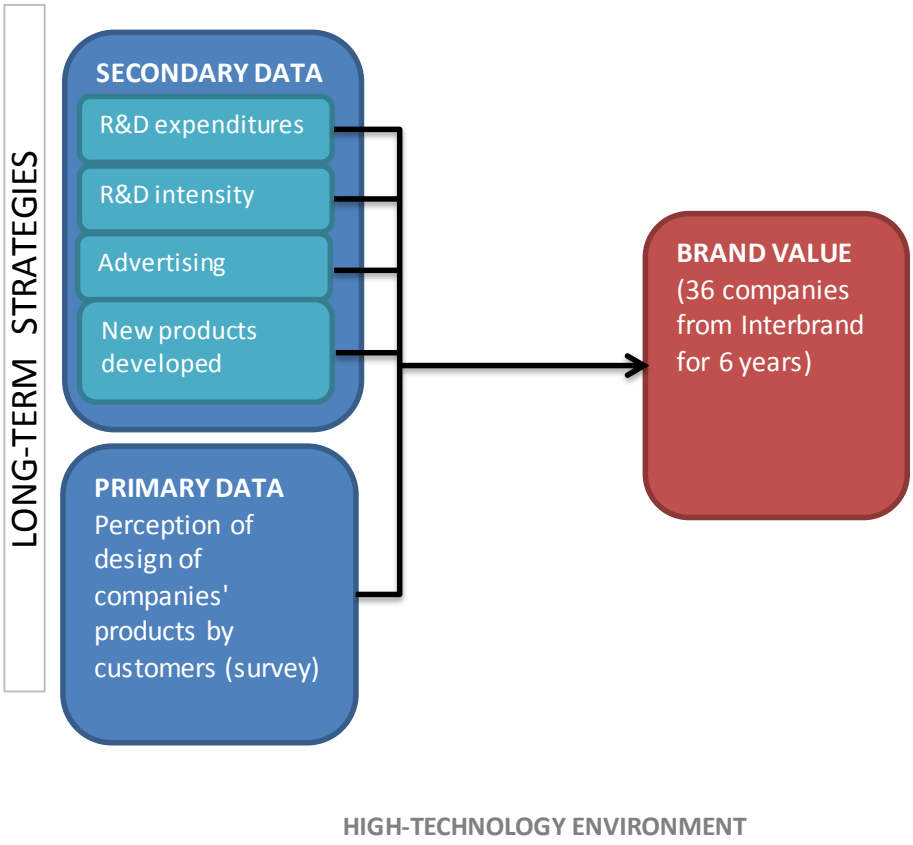

Figure 1. Theoretical framework of the thesis.

The figure above depicts the main theoretical concepts of the thesis and their interrelation. The theoretical framework presents the main hypothesis of the thesis: brand value of high-technology companies is correlated with long-term brand development strategies. In other words the higher the inputs from the companies in terms of R&D expenditures, R&D intensity, new products (NP) developed, and advertising – the higher the brand value of the selected companies with respect to the time lag between the strategies' implementation and brand value measurement. The same is applied to the design component: the higher the perception of design of

companies' products by the customers – the higher companies' brand value.

1.6. Research methodology

Theoretical part of the current research will be done using the literature available on long- and short-term brand development strategies, their influence on brand value and/or brand equity of the companies, high-technology environment and industries. The theory will be built using the information in related books and journals, as well as the Internet publications.

Empirical part of the research will be conducted using primary and secondary data. Primary data collected from the survey will be utilized for establishing the association between design and brand value of the companies. In order to see the correlation between the brand values of the chosen companies and determinants, namely investments in R&D, R&D intensity, advertising, new products developed, and design the data from Interbrand will be used on one side and information about the companies on the other side. The companies' data will be acquired mainly from the annual reports of the companies from years 2008 to 2013, previous research done, and other documentary sources. Moreover, for better understanding of the subject social networking sites and separate pages of the analyzed companies on these sites will be studied.

The information collected (on five studied variables) will be linked to brand value of the companies, or in other words, the proposition will be built on how these five determinants influence the brand value of the companies.

The sample will include 36 companies operating in the environment of high-technology and being listed and ranked by Interbrand brand Consultancy Company as Top 100 most valuable brands in each ranking from 2008 to 2013 (having 6 repeat rankings). The areas, which the

companies operate in, include technology, telecommunications, automotive, business services, digital, and energy.

The current research will be exploratory in nature, since its aim is discover new ideas (Naoum, 2007) in the brand value creation. Since, the ultimate goal of the research is to find out how five variables impact the brand value, the further implications and possible improvements in the brand value will be suggested, thus making the study a normative one.

Since no extensive research has been done on studying the effect of long-term brand strategies on the brand value of high-technology companies, it is onerously to determine the reliability of the chosen determinants. Nevertheless, based on the previous research done for different types of industries, the picked determinants should produce reliable results and have a certain influence on the brand value. On the other hand internal validity of the chosen determinants is predicted to be high, since the preliminary research overview suggests that the chosen long-term brand strategies should have an effect on the brand value of a company. However, the external validity is hard to estimate, since the research will cover only 36 companies included into Interbrand ranking during six consecutive years. Thus, it might be difficult to generalize the findings on other companies operating in high-technology environment.

1.7. Delimitations

As any other research this one has its delimitations. First of all the present research considers only the high-technology companies, listed by Interbrand Top 100 in 2013. The selection of the companies is done by Interbrand by using different criteria including financial analysis of the companies, Role of Brand Index, and Brand Strength Score. Moreover, the list of the companies included in Interbrand Top 100 change from year to year, and some companies drop off the list. But they are still interesting

to analyze. Thus, since this research is based only on six years indices of Interbrand (from 2008 to 2013), it is limited within these years' results.

The present research studies the effect of long-term brand strategies, including advertising expenditures, R&D expenditures, R&D intensity and NPD as well as general effect of design on brand value of the selected companies. Short-term strategies are not being in the focus of the current study, though for the future research it would be interesting to compare the effect of long-term brand strategies and short-term brand strategies on brand value of high-technology companies.

Moreover, brand value chain is to be discussed in the present research. But this study excludes the analysis of different dimensions of brand value chain: how long-term brand strategies affect a particular element of the brand value chain. For the future research it would be interesting to find out how discussed strategies influence customer mindset or brand performance for instance. Furthermore, different elements of brand performance might be analyzed separately.

High-technology environment is different from other industries and companies operating there experience different effect of the strategies applied on the brand value. This study will provide an insight of how long-term brand strategies affect the brands of high-technology companies. From theoretical perspective it will be a valuable addition to the research done on this topic, since none of the research has studied the impact of long-term strategies on the brand value of high-technology firms.

1.8. Organization of the study

The rest of the thesis is structured as following. The next three chapters will comprise theoretical part of the thesis. In the first chapter (2) high-technology industries and high-technology companies will be discussed

from the theoretical point of view. And the built index for identifying high-technology companies from Interbrand ranking will be introduced.

The next two chapters 3 and 4 will build the theory on brand value and brand development strategies. The sub-chapters 3.1 and 3.2 will familiarize the readers with the process of brand value creation and the methods of its calculation. The overview of Interbrand Top 100 Ranking will be done in the sub-chapter 3.3. In this section the method for calculating the brand value, used by Interbrand will be discussed. This sub-chapter also describes high-technology companies included into the research by the segments of industry they belong to. Moreover, The Chapter 3 includes the alternative ways for calculating and assessing the brand and its value.

The Chapter 4 will define long-term brand development strategies and how researchers have identified their impact on a company's brand value. The theoretical part will be ended up by research hypotheses presentation.

The Chapter 5 incorporates the empirical part of the study. The sub-chapter 5.1 covers the research methodology. This part discusses type of the research, research methods used, collection of the data and description of the sample together with sampling technique. The second sub-chapter deals with actual data analysis and findings of the research. Here the results of the empirical part are presented and analyzed.

The Chapter 6 includes the discussion of the findings, as well as the limitations of the study and further research directions. The chapter is concluded with the managerial implications of the study. The last chapter concludes the thesis. It summarizes theoretical and empirical sections of the study, along with findings of the research.

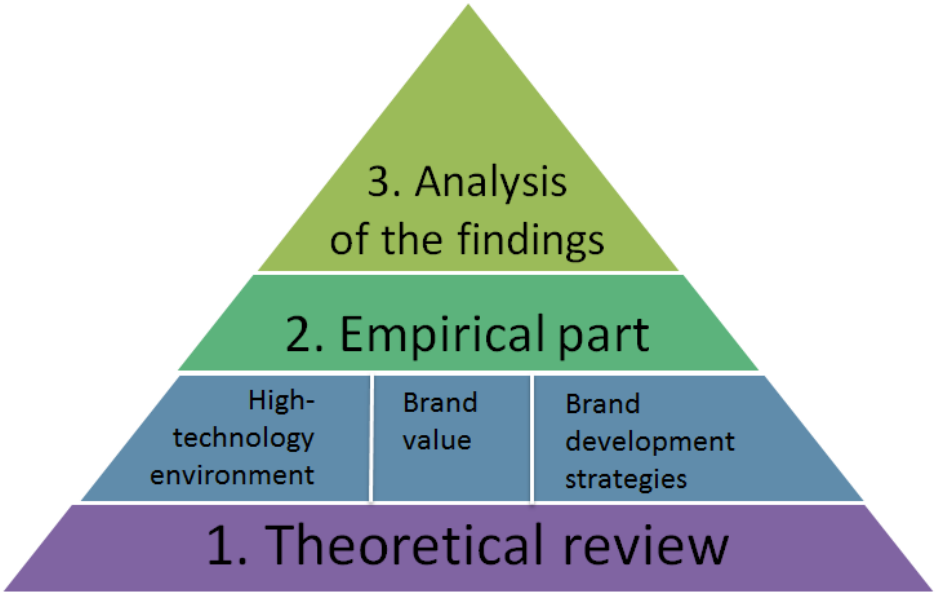

Figure 2. Research framework of the thesis.

The figure above concludes the structure of the thesis, outlined previously. Thus, starting with the theoretical overview on three key aspects (high-technology environment, brand value, and brand development strategies), it will then present the empirical part of the conducted study, which is followed by the analysis and discussion of the findings.

2. HIGH-TECHNOLOGY ENVIRONMENT AND HIGH-TECHNOLOGY INDUSTRIES

The Chapter 2 covers the theoretical review on high-technology environment and high-technology industries. The purpose of this chapter is to familiarize the readers with the study target companies and the area of their operation.

The present study's focus is on high-technology companies, ranked by Interbrand to have the best 100 brand value across six years from 2008 to 2013. Thus, there is a necessity to define high-technology industries and high-technology companies in order to select these companies from the Interbrand rating. This chapter will build the theory around high-technology environment, define the criteria for the companies to be defined as high-technology and present the index for assessing Interbrand ranked companies on these criteria.

2.1. High-technology definition

Defining high-technology as such is crucial for the present study. This will impact on the choice of the companies from the Interbrand list. There are plenty of definitions of high-technology given by researchers, countries' statistics bureaus, and companies themselves. The criteria for defining high-technology also vary. For the purpose of this study a list of criteria will be built as well further on.

Many researchers have encountered the difficulty of identifying what is high-technology and what are the characteristics of high-technology industry. Thus, for instance, Hatzichronoglou (1997) stresses out the difficulties associated with this task. He states that there are three types of difficulties, including determining an industry's technology content, deciding on whether high-technology industry produces technology or

actively uses it, and subjective thinking on deciding between several industries classes.

The first difficulty according to Hatzichronoglou (1997) is overcome partly by using R&D intensity as a criterion. The second challenge is solved by measuring both direct and indirect R&D intensity. The former was calculated by OECD by weighting each manufacturing sector (22 of them in total) for its share in production of ten OECD countries. The latter the research has taken into account R&D expenditures being part of intermediates. The result of this research was a classification of industries according to the level of their technology-involvement. The table below gives full information on the classification.

Table 2. Classification of manufacturing industries (Hatzichronoglou, 1997).

Level of technological intensity	**Industries**
High-technology	1. Aerospace 2. Computers, office machinery 3. Electronics-communications 4. Pharmaceuticals
Medium-high-technology	5. Scientific instruments 6. Motor vehicles 7. Electrical machinery 8. Chemicals 9. Other transport equipment 10. Non-electrical machinery
Medium-low-technology	11. Rubber and plastic products 12. Shipbuilding 13. Other manufacturing 14. Non-ferrous metals 15. Non-metallic mineral products 16. Fabricated metal products 17. Petroleum refining 18. Ferrous metals
Low-technology	19. Paper printing 20. Textile and clothing 21. Food, beverages, and tobacco 22. Wood and furniture

The research findings by Hatzichronoglou were later used by another researcher Loschky (2010). Loschky also suggested to measure and define high-technology by R&D intensity, taking into account direct and indirect R&D intensity. His research was a review of the previously made study done by Hatzichronoglou in 1997. The result of the study of 25 countries by Loschky was an updated list of the industries organized in the order of their R&D intensity. Loschky proposed the thresholds for classifying the industries:

- R&D intensity below 1% - low-technology;
- R&D intensity between 1% and 2.5% - medium-low-technology;
- R&D intensity between 2.5% and 8% - medium-high-technology;
- R&D intensity higher than 8% - high-technology.

By utilizing these thresholds Loschky has classified the industries, which is an updated list from 1997 done by Hatzichronoglou. The list is presented in Table 3. The method used by OECD and its researchers (Hatzichronoglou, Loschky) was utilized in other studies as well. Thus, for example, Haverila (2013) used it for defining high-technology companies when identifying marketing metrics variables linked to successful entry on international markets by high-technology companies.

Table 3. Classification of industries (Loschky, 2010).

Level of technological intensity	**Industries**
High-technology	1. Pharmaceuticals 2. Medical, precision & optical instruments 3. Radio, television & communication equipment 4. Aircraft & spacecraft 5. Office, accounting & computing machinery
Medium-high-technology	6. Railroad equipment & transport equipment 7. Motor vehicles, trailers & semi-trailers 8. Electrical machinery & apparatus, n.e.c. 9. Machinery & equipment, n.e.c.
Medium-low-technology	10. Chemicals excluding pharmaceuticals 11. Rubber & plastics products 12. Building & repairing of ships & boats 13. Manufacturing n.e.c.; recycling 14. Other non-metallic mineral products

	15. Fabricated metal products, except machinery & equipment 16. Non-ferrous metals 17. Pulp, paper, paper products, printing and publishing
Low-technology	18. Textiles, textile products, leather and footwear 19. Food products, beverages and tobacco 20. Iron & steel 21. Coke, refined petroleum products and nuclear fuel 22. Wood and products of wood and cork

Clearly, there are other criteria commonly used by the researchers. In such a way, Riche, Hecker and Burgan (1983) suggested that the benchmarks for identifying high-technology include R&D expenditures, the number of technical staff relative to the total number of employees, and product sophistication.

R&D expenditures or R&D investments has become an important criteria for many studies done. Thus, for example, European Commission creates a R&D Scorecard each year for top 2000 companies worldwide. There is often, but not always, that companies operating in high-technology industries invest heavily in R&D. The Scorecard by European Commission in 2013 listed such companies as Volkswagen, Samsung Electronics, Microsoft, Intel and many other famous names at the top. The top 50 companies are displayed in the Appendix 1. (European Commission, 2013). The list of the top 50 companies already gives an understanding companies from which industries invest more in R&D.

Defining high-technology is difficult; there is no a single agreed-upon definition, which everybody can use. Depending on how to look at high-technology, criteria for its defining will differ. But there have been made efforts in defining high-technology. For example, Mohr, Sengupta and Slater (2010, 9) define high-technology as *"cutting-edge or advanced technology"*. And the authors admit that the definition of high-technology in this case will shift over time. In a similar way high-technology was defined

by Rexroad (1983, 3): *"... the segment of technology considered to be nearer to the leading edge or the state of the art of a particular field. It is that technology inherent in emerging from the laboratory into practical application".* These two definitions both state that state of the art technology or cutting-edge technology is an essential part of high-technology.

A bit different perspective on high-technology definition was taken by Grønhaug and Möller (2005), who noticed that the term high-technology is often associated with creation and use of new technologies. And the authors also note the importance of these technologies to be "advanced". The question arises how to measure the level of advancement and the level of "state of art" of technologies. Grønhaug and Möller (2005) suggest that R&D investment is a reliable indicator, since the aim of R&D investment is to bring novel products, services, and ideas.

Some characteristics of high-technology from the marketing point of view are given by Mohr, Sengupta and Slater (2010, 11-16) and Bidgoli (2010, 424), who see high-technology environment being characterized by three kinds of uncertainty, including technology uncertainty, market uncertainty, and competitive volatility.

Gardner, Johnson, Lee, and Wilkinson (2000, 1056) proposed another definition of high-technology in relation to marketing: *"products that are the result of turbulent technology and which require substantial shifts in behavior of at least one member of the product usage channel"*. From this definition the importance of change in usage of the product or service, as well as the turbulence of technology, are important.

Many researchers also refer to high-technology companies as those developing and manufacturing products and services, which include innovative technologies (Seyoum, 2005). Seyoum (2005) also agrees with Keeble's and Wilkinson's (2000) method of identification of high-

technology companies – high research and development expenditures. Here, however, the question of what is considered high and low in terms of research and development expenditures, what number should be used as a threshold.

Another interesting notion, regarding identifying high-technology firms, is that in order to grow high-technology companies need to be able to interact with others in the industry and outside it. (Seyoum 2005; Boter & Holmquist 1996). Besides that, Seyoum (2005) presents a number of catalysts for high-technology companies and industries. Those include labor mobility, specialty suppliers, legal assistance and contract manufacturing. The reason behind choosing these characteristics is that rapid exchange of information and flow of knowledge is vital for a high-technology company, both among inside and outside stakeholders.

The definitions given by several researchers and presented above highlight the importance of some particular aspects regarding identifying high-technology itself, high-technology industries and high-technology companies. Among the features inherent in high-technology definitions are such aspects as R&D expenditures and R&D intensity. Concerning a high-technology company two more dimensions can be set as criteria: the industry it operates in and the level of interaction and cooperation, into which the company is involved. These elements help to better define high-technology and are the ones, on which an index for evaluating selected companies from Interbrand will be built in the next sub-chapter.

2.2. High-technology index for evaluating top Interbrand companies

As it has been set earlier the high-technology companies being in Top 100 of Interbrand listing will be studied in the present research. Those high-technology companies have been selected based on the index created based on the previous theory available and literature review made. First, important criteria for defining high-technology companies have been

identified, including R&D expenditures, R&D intensity, industries of operation and the level of interaction. Due to the availability of data, the last criterion has to be omitted. Moreover, the first criterion – R&D expenditures – even though taken into consideration and being present in the index does not bring any scores to the companies in relation to high-technology. Due to different companies' sizes, sales volumes and profits, this element can be considered only in relation to companies' sales, which leads to the second criterion of R&D intensity.

First based on Interbrand rankings from the last six years from 2008 to 2013 companies with six repeat rankings have been chosen. There are 80 of such companies. Next, all the companies were evaluated based on the elements of high-technology. The following table is the summary of the companies' scores on the selected criteria.

Table 4. High-technology index of Top 100 Interbrand companies with six repeat rankings.

		CRITERIA					
		R&D expenditures	R&D intensity		Industry*		TOTAL SCORE
Num	Companies	$ m	%	Score	Type	Score	
1	Cola	N/A	N/A	**N/A**	19	**0**	**N/A**
2	IBM	6026	6,03%	**5**	5	**3**	**8**
3	Microsoft	10411	13,37%	**7**	5	**3**	**10**
4	GE	4750	3,25%	**3**	8	**2**	**5**
5	Nokia	620	17,84%	**7**	3	**3**	**10**
6	Toyota	8584	3,66%	**3**	7	**2**	**5**
7	Intel	10611	20,13%	**7**	5	**3**	**10**
8	McDonald's	N/A	N/A	**N/A**	19	**0**	**N/A**
9	Disney	N/A	N/A	**N/A**	N/A	**0**	**N/A**
10	Google	8000	13,37%	**7**	3	**3**	**10**
11	Mercedez-Benz	4964	5,80%	**4**	7	**2**	**6**
12	HP	3135	2,80%	**2**	5	**3**	**5**
13	BMW	4388	4,79%	**4**	7	**2**	**6**
14	Gilette	182,07	2,40%	**2**	13	**1**	**3**
15	American Express	N/A	N/A	**N/A**	N/A	**0**	**N/A**
16	Louis Vuitton	N/A	N/A	**N/A**	18	**0**	**N/A**
17	Cisco	5942	12,22%	**7**	3	**3**	**10**
18	Citi	N/A	N/A	**N/A**	N/A	**0**	**N/A**
19	Honda	6750	5,67%	**4**	7	**2**	**6**
20	Samsung	9848	5,25%	**4**	8	**2**	**6**
21	H&M	N/A	N/A	**N/A**	18	**2**	**N/A**
22	Oracle	4498	13,00%	**7**	5	**3**	**10**
23	Apple	4475	2,62%	**2**	5	**3**	**5**
24	Sony	4851	6,96%	**5**	8	**2**	**7**
25	Pepsico	665	1,00%	**0**	19	**0**	**0**
26	HSBC	N/A	N/A	**N/A**	N/A	**0**	**N/A**
27	Nescafe	176	1,63%	**1**	19	**0**	**1**
28	Nike	N/A	N/A	**N/A**	18	**0**	**N/A**
29	UPS	N/A	N/A	**N/A**	N/A	**0**	**N/A**
30	SAP	3148	14,00%	**7**	5	**3**	**10**
31	Dell	1072	1,88%	**1**	5	**3**	**4**
32	Budweiser	N/A	N/A	**N/A**	19	**0**	**N/A**
33	Ikea	N/A	N/A	**N/A**	22	**0**	**N/A**
34	Canon	2917	8,21%	**6**	8	**0**	**6**
35	J.P. Morgan	N/A	N/A	**N/A**	N/A	**0**	**N/A**
36	Goldman Sachs	N/A	N/A	**N/A**	N/A	**0**	**N/A**
37	Kellogg's	199	1,35%	**1**	19	**0**	**1**
38	Nintendo	569	8,42%	**6**	13	**1**	**7**
39	Morgan Stanley	N/A	N/A	**N/A**	N/A	**0**	**N/A**
40	Philips	2389	7,43%	**6**	8	**2**	**8**

41	Thomson Reuters	N/A	N/A	**N/A**	N/A	**0**	**N/A**
42	Gucci	N/A	N/A	**N/A**	18	**0**	**N/A**
43	Ebay	1768	11,02%	**7**	3	**3**	**10**
44	Accenture	715	2,50%	**2**	N/A	**0**	**2**
45	Siemens	5799	5,66%	**4**	8	**2**	**6**
46	Ford	6600	4,36%	**3**	7	**2**	**5**
47	Harley-Davidson	152	2,58%	**2**	7	**2**	**4**
48	L'Oreal	857	3,70%	**3**	10	**1**	**4**
49	MTV	N/A	N/A	**N/A**	N/A	**0**	**N/A**
50	VW	15595	5,96%	**4**	7	**2**	**6**
51	AXA	N/A	N/A	**N/A**	N/A	**0**	**N/A**
52	Heinz	N/A	N/A	**N/A**	19	**0**	**N/A**
53	Colgate	267	1,53%	**1**	10	**1**	**2**
54	Amazon	4564	7,47%	**6**	3	**3**	**9**
55	Xerox	601	2,80%	**2**	8	**2**	**4**
56	Zara	N/A	N/A	**N/A**	18	**0**	**N/A**
57	Nestle	1689	1,63%	**1**	19	**0**	**1**
58	KFC	31	0,28%	**0**	19	**0**	**0**
59	Danone	365	1,29%	**1**	19	**0**	**1**
60	Audi	5470	7,95%	**6**	7	**2**	**8**
61	Caterpillar	2046	3,68%	**3**	6	**2**	**5**
62	Avon	67,2	0,68%	**0**	10	**1**	**1**
63	Adidas	170	0,88%	**0**	18	**0**	**0**
64	Hyundai	1641	2,19%	**2**	7	**2**	**4**
65	Kleenex	112,32	1,70%	**1**	17	**1**	**2**
66	Porsche	1137	5,96%	**5**	7	**2**	**7**
67	Hermes	N/A	N/A	**N/A**	18	**0**	**N/A**
68	GAP	N/A	N/A	**N/A**	18	**0**	**N/A**
69	Panasonic	5144	6,88%	**5**	8	**2**	**7**
70	Cartier	N/A	N/A	**N/A**	14/15	**1**	**N/A**
71	Tiffany and Co.	N/A	N/A	**N/A**	14/15	**1**	**N/A**
72	Pizza Hut	31	0,28%	**0**	19	**1**	**1**
73	Allianz	N/A	N/A	**N/A**	N/A	**0**	**N/A**
74	Moet & Chandon	N/A	N/A	**N/A**	19	**1**	**N/A**
75	Starbucks	N/A	N/A	**N/A**	19	**1**	**N/A**
76	Smirnoff	31,8	0,13%	**0**	19	**1**	**1**
77	Johnson-Johnson	8200	11,50%	**7**	10	**1**	**8**
78	Ferrari	183	6,34%	**5**	7	**2**	**7**
79	Shell	1318	0,29%	**0**	21	**0**	**0**
80	Visa	N/A	N/A	**N/A**	N/A	**0**	**N/A**

The table shows how 80 selected companies with six repeat rankings from 2008 to 2013 score on two elements: R&D intensity (measured as percentage of R&D expenditures from total sales) and affiliation into a particular industry.

The data for R&D expenditures and companies' sales was obtained from companies' annual reports from 2013. R&D intensity was calculated in

compliance with retrieved figures. The scores for R&D intensity were distributed according to the thresholds, presented in Table 5.

Table 5. Thresholds for distributing R&D intensity scores.

Upper limits	Labels	Score
N/A	N/A	N/A
1,00%	0,13%-1,00%	0
2,00%	1,01%-2,00%	1
3,00%	2,01%-3,00%	2
4,79%	3,01%-4,79%	3
6,00%	4,8%-6,00%	4
7,00%	6,01%-7,00%	5
9,00%	7,01%-9,00%	6
20,13%	9,01%-20,13%	7

These thresholds were identified to classify the companies according to their R&D intensity. Full description of data is presented in the Appendix 2. Due to the fact that the companies report their activity differently and might include different expenses into research and development budget or be reported within R&D expenditures of a parent company, some inaccuracy is present. Thus, Gilette, being part of Procter & Gamble Co., contributes 9% of total sales of Procter & Gamble. Accordingly, 9% of the total R&D budget of Procter & Gamble has been reported as R&D expenditures of Gilette. A similar situation is for Nescafe, which is a part of Nestle S.A. Since, Nescafe is carrying 10.44% of Nestle's sales; R&D expenditures for Nescafe have been calculated respectively as 10.44% of Nestle's R&D budget. Moreover, an exchange rate used for converting a Swiss franc into a dollar has been taken as reported by Nestle: CHF0.89=$1.

KFC and Pizza Hut, being both in the Top 100 brands, are the part of Yum! Brands. Since there is no data available on how much these two brands contribute to the total Yum! Brands sales, R&D expenditures and R&D intensity of Yum! Brands have been reported as R&D expenditures and R&D intensity of KFC and Pizza Hut. The same situation is for

Smirnoff brand, which is one of several brands in Diageo group and the figures for which have been reported by using R&D expenses and revenues from Diageo group.

Another brand Kleenex is also a part of a bigger group – Kimberley-Clark Corporation. R&D intensity for Kleenex has been calculated based on R&D expenditures and sales of 31.2% of the total Kimberley-Clark's figures, which is percentage contributed by a consumer tissue segment. Similar situation exists for Porsche, which is currently a part of Volkswagen. R&D budget and sales for Porsche have been reported as 7.29% of Volkswagen's total R&D expenses and revenues.

The data for Samsung, Hyundai and Amazon dates 2012, since there are no annual reports for 2013 announced for these companies yet. Moreover, R&D expenses for Amazon are reported in the annual report as technology and content expenses. Another notion concerns Adidas brand, for which the exchange rate from euro to a dollar has been used as reported by the company: €0.753=$1. Danone, a company which also reports all figures in euro, does not provide used exchange rate. Thus, the exchange rate for Danone has been calculated based on the average exchange rate of euro and dollar for 2013 reported by Bank of Finland (2013): €0.753=$1.

Affiliation to a particular industry has been measured according to OECD classification done by Loschky (2010). The scores for belonging to a particular industry are given in Table 6.

Table 6. Scores for affiliation to a particular industry.

Level of technology sophistication	Industry	Score
High-technology	1. Pharmaceuticals 2. Medical, precision & optical instruments 3. Radio, television & communication equipment 4. Aircraft & spacecraft 5. Office, accounting & computing machinery	**3**
Medium-high-technology	6. Railroad equipment & transport equipment 7. Motor vehicles, trailers & semi-trailers 8. Electrical machinery & apparatus, n.e.c. 9. Machinery & equipment, n.e.c.	**2**
Medium-low-technology	10. Chemicals excluding pharmaceuticals 11. Rubber & plastics products 12. Building & repairing of ships & boats 13. Manufacturing n.e.c.; recycling 14. Other non-metallic mineral products 15. Fabricated metal products, except machinery & equipment 16. Non-ferrous metals 17. Pulp, paper, paper products, printing and publishing	**1**
Low-technology	18. Textiles, textile products, leather and footwear 19. Food products, beverages and tobacco 20. Iron & steel 21. Coke, refined petroleum products and nuclear fuel 22. Wood and products of wood and cork	**0**

Based on the criteria (R&D intensity and affiliation to an industry) the total scores in relation to high-technology have been calculated for each of 80 companies (Table 4). All the companies with the total score of 4 or higher have been considered as high-technology companies. The final list of the selected companies is presented in Table 7 and includes in total 36 companies.

Table 7. Selected high-technology companies.

		CRITERIA					
		R&D expenditures	R&D intensity		Industry		TOTAL SCORE
Number	Companies	$ m	%	Score	Type	Score	
1	IBM	6026	6,03%	5	5	3	8
2	Microsoft	10411	13,37%	7	5	3	10
3	GE	4750	3,25%	3	8	2	5
4	Nokia	620	17,84%	7	3	3	10
5	Toyota	8584	3,66%	3	7	2	5
6	Intel	10611	20,13%	7	5	3	10
7	Google	8000	13,37%	7	3	3	10
8	Mercedez-Benz	4964	5,80%	4	7	2	6
9	HP	3135	2,80%	2	5	3	5
10	BMW	4388	4,79%	4	7	2	6
11	Cisco	5942	12,22%	7	3	3	10
12	Honda	6750	5,67%	4	7	2	6
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14	Oracle	4498	13,00%	7	5	3	10
15	Apple	4475	2,62%	2	5	3	5
16	Sony	4851	6,96%	5	8	2	7
17	SAP	3148	14,00%	7	5	3	10
18	Dell	1072	1,88%	1	5	3	4
19	Canon	2917	8,21%	6	8	0	6
20	Nintendo	569	8,42%	6	13	1	7
21	Philips	2389	7,43%	6	8	2	8
22	Ebay	1768	11,02%	7	3	3	10
23	Siemens	5799	5,66%	4	8	2	6
24	Ford	6600	4,36%	3	7	2	5
25	Harley-Davidson	152	2,58%	2	7	2	4
26	L'Oreal	857	3,70%	3	10	1	4
27	VW	15595	5,96%	4	7	2	6
28	Amazon	4564	7,47%	6	3	3	9
29	Xerox	601	2,80%	2	8	2	4
30	Audi	5470	7,95%	6	7	2	8
31	Caterpillar	2046	3,68%	3	6	2	5
32	Hyundai	1641	2,19%	2	7	2	4
33	Porsche	1137	5,96%	5	7	2	7
34	Panasonic	5144	6,88%	5	8	2	7
35	Johnson-Johnson	8200	11,50%	7	10	1	8
36	Ferrari	183	6,34%	5	7	2	7

These 36 companies are defined as high-technology and will be further analyzed in the current study in relation to their brand value, the topic that is elaborated in the following sub-chapter.

3. BRAND VALUE

The purpose of this chapter is to reflect on the previous research done on brand development strategies and brand value creation. In this chapter the brand value generation process will be discussed, as well as the methods and approaches for its computing and evaluating.

3.1. Brand value generation

There are several ways of defining brand value and some researchers equate brand value to brand equity, while others differentiate these two concepts. Kapferer (2008, 14) defines brand value as *"the ability of brands to deliver profits"* or in other words it is the cashflow that a brand produces after deducting the costs. The importance of this definition is that a brand in a simple sense should serve the goals of a business, from which the primary one is producing profit. Kapferer does not distinguish between brand value and brand equity.

On the other hand Raggio and Leone (2007a, 248-249) make a distinction between these two notions. They see brand equity as a driving force for brand value, which is defines as *"sale of replacement price of a brand"*. Interestingly, Raggio and Leone (2007b) identify two levels of brand value: current and appropriable. The former is available to a company at a particular time with the resources and strategies, that a company owns and implements at this time point. Yet, appropriable brand value is possible to achieve for a company if it manages its brand equity better, which in turn can influence positively brand value. The logic of current and appropriable brand value is presented in Figure 3.

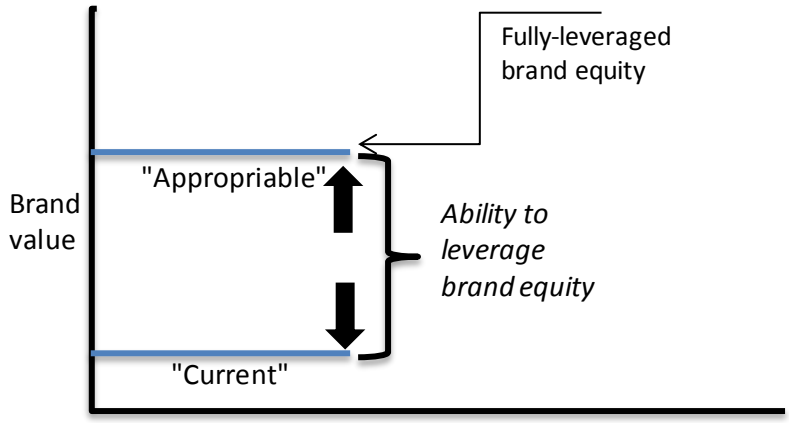

Figure 3. Brand value levels (Raggio & Leone, 2007b).

Thus, the authors of this idea see well-managed brand equity as a prerequisite to a high brand value. On the contrary, not everybody makes a distinction between brand value and brand equity. Thus, Keller and Lehmann (2003, 2) state the importance of proper management of *"brands to maximize their value – or brand equity…"* The authors are thus considering the value and equity of a brand the same. Neglecting a certain extent of confusion in the terminology, Keller and Lehmann (2003) suggested the approach to look at brand value generation – brand value chain. Defined in the introductory part of the present study, brand value chain consists of four value stages: investment in marketing program, customer mindset, brand performance and shareholder value. The central idea of the brand value model (Figure 4) is that different parties influence the brand value on the way of its generation, while they of course need different information, since they make different decision and impact the brand value in completely diverse ways.

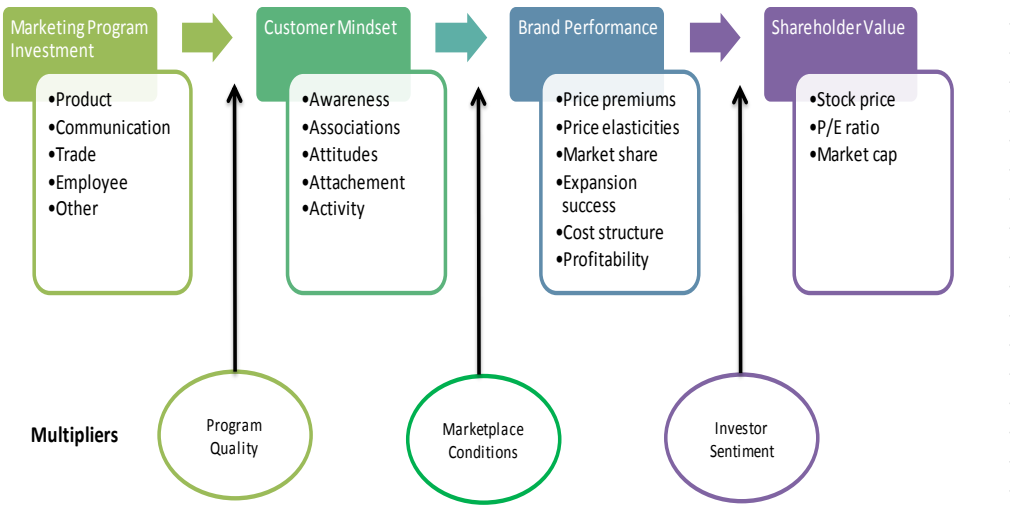

Figure 4. Brand value chain (Keller & Lehmann, 2003).

Another perspective on brand value generation has been expressed by Jones (2005). He suggests that for a high brand value management of relationships with stakeholders should be appropriate. Thus, interaction with strategic stakeholders is considered necessary for creating brand value. An important notion, made by Jones, is the importance of not a single relationship brand-customer, but a whole network of relationships, contributing to brand value generation in a long-run.

In the present study branding and brand value creation is seen in the light of high-technology markets and companies. Branding is indeed important for high-technology companies, which cannot compete only on performance characteristics. Instead, a strong brand might lead to long-lasting success of a company (Kapur, Peters & Berman, 2003). Similar idea was shared by Ward, Light and Goldstine (1999), who see price and performance are just as a prerequisite for entering the industry. They see brands and brand management as a tool for differentiating company's products or services and leading to such benefits as customer loyalty and better relationships with stakeholders. Another research, studying the importance of a single component of brand equity for high-technology markets – brand attitude – was done by Aaker and Jacobson (2001). The findings of the research showed that the investments associated with

building brand attitude pay off for high-technology companies in terms of increased firm value.

Several researchers studied the antecedents of brand value generation in order to understand the prerequisites to create brand value for a company and to influence it by means of these drivers. These antecedents might influence a brand in a short- and long-run, yet short-term drivers are supposed to bring limited benefits to the brand value creation (Mela, Ataman & Heerde, 2006), while long-term strategies allow to build long-lasting brand value. Different brand development strategies are discussed more closely in the sub-chapter 2.3.

3.2. Brand value calculation approaches

The importance of brand value creation has been declared a lot. Yet there are no single approach existing for calculating brand value in order to state brand's economic value. Companies feel the need for brand value calculation for several reasons. By measuring brand value companies are able to understand how brands are valuable to them, in which way, how they shape their relationships with the customers and other stakeholders, how brands contribute to achievement of general business ideas and goals. (Ind, 2007, 156)

There are several methods generally used for brand value assessment, but great deal of variations exists. Jan Lindemann (2010, 21-56) in his book "The Economy of Brands" identifies three broad categories for brand valuation. The first category includes market-research-based models or brand equity models. The aim of the models, falling into this group, is to measure customer-brand relationships. The drawback of these models is that they do not provide financial assessment of a brand. On the contrary they determine what relationships the customers have with the brand by using specific dimensions. While not providing financial measurement of a

brand, these models are able to assess effectiveness of marketing communication.

The second approach to brand valuation is financial one and assesses a brand in terms of delivering financial value. The methods belonging to this category measures brand value as value of any other commercial asset. The main sub-categories of this group of models are income-based and comparable. The models assess economic value generated by a brand, while giving no information on how generated economic value of a brand is linked to the customers' perceptions about the brand.

The last category of brand valuation models combines two first ones by using consumer perceptions as well as purely financial analysis for measuring brand value and is called "economic use" method. Because these models use both, marketing and financial approaches, they are the most advanced and difficult to implement.

The first two approaches do not always provide reliable results, thus causing the need to use the third one, which is done by several consulting companies, Interbrand being one of them.

3.3. Interbrand's brand value calculation

This section describes the rating done by Interbrand branding consultancy. The sub-chapter includes general overview of the company, brand value calculation method used by Interbrand and description of the companies' operating in high-technology sector and being included into Interbrand's top 100 during the last six years. Moreover, alternative approaches and indices for calculating and assessing brand value will be presented.

3.3.1. Interbrand overview

Interbrand is the biggest brand consultancy in the world, established in 1974 and having 40 offices spread across different continents (Interbrand, 2014a). The company deals with such disciplines as analytics, brand strategy, brand valuation, corporate citizenship, corporate design, digital, digital brand management, health, internal brand engagement, naming, packaging design, retail and verbal identity (Interbrand, 2014b). Interbrand serves a wide range of industries, including automotive, consumer products, energy, financial services and other (full list of Interbrand work by industry is presented in Appendix 3) (Interbrand, 2014c) and provides services for such companies as 3M, AT&T, Bing Microsoft, Holiday Inn, Huawei, Mazda, Nissan, UniCredit to give a few examples of Intebrand clients (Interbrand, 2014d).

Each year Interbrand publishes a new top 100 Best Global Brands, having for the moment rankings from 2000 till 2013. Interbrand calculates economic value of each brand using its method, which is described in detail in the following sub-chapter. Besides creating the ranking for Best Global Brands, the consultancy also develops the ranking of Best Global Green Brands and rankings done by region or country.

For the brands in order to be considered as the best global brands, they have to fulfill several criteria. Thus, a brand has to be valued of more than $1 billion and get one third of its earnings outside of its domestic country. (Dinnie, 2008, 65; Interbrand, 2014e) Important for inclusion into the list is that a brand is global – it should be present across main economic areas around the world and serve primary markets. The exact criteria for brand admittance into the Best Global Brand list are the following:

1. 30% of its earnings should come outside of the domestic region.
2. A brand should be present in minimum three main continents, while having wide coverage of emerging markets as well.
3. Marketing and financial data should be publicly available.

4. A brand should deliver positive economic results over a long period of time.
5. Brand should be publicly known, brand awareness is expected to be beyond brand's own market. (Interbrand, 2014e)

Definitely, applying these criteria on brands, exclude some widely-known brands from consideration. If a brand is privately owned and has limited public financial or marketing information, it cannot be reckoned. Furthermore, implication of the above-mentioned criteria, lead to omitting some industries from consideration because of some industries specificities.

3.3.2. Interbrand's brand calculation approach

As discussed in chapter 2, Interbrand applies "economic use" approach for brand value calculation. This means usage of both marketing and financial assessment methods. "Economic use" approach, because of incorporating two sides (marketing and financial) for brand calculation, is the most sophisticated and difficult to conduct one (Lindemann, 2010, 49-56).

Interbrand's brand assessment approach is based on three pillars: financial performance, role of brand in customer buying decisions and competitive analysis. The algorithm for brand value calculation, used by Interbrand, is presented in Figure 5.

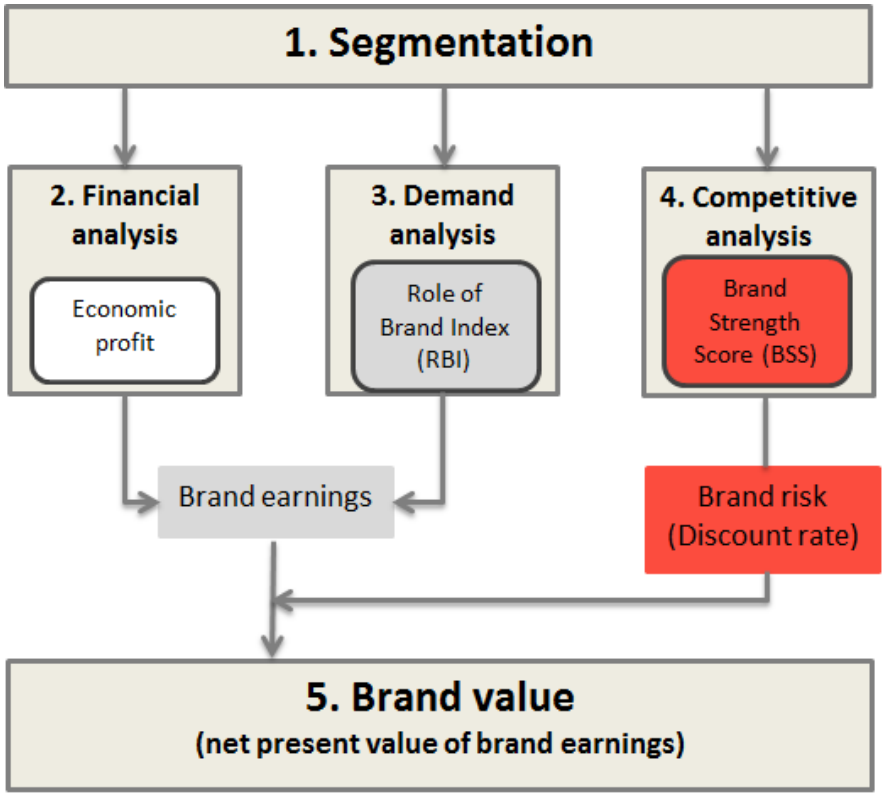

Figure 5. Interbrand's brand value approach (Rocha, 2014a).

The first step includes segmentation, which is assessing the brands according to the above-mentioned criteria. This creates a pool of prospective best global brands. The following part of brand assessment includes three simultaneous parts: financial analysis, demand analysis and competitive analysis.

Financial part of the analysis measures economic profit, which is the profit generated by the branded products after subtracting operating costs, taxes and charges for profit generation (Lindemann, 2010, 51; Interbrand, 2014e). Then, financial forecasts for five years are built for the brand, creating a basis for brand valuation model (Interbrand, 2014e).

Along with financial test, demand analysis is made. This part of the analysis is aimed at understanding customer purchasing behavior – how the brand influences the choice of the customer. What is exactly measured is what portion of purchasing decision is due to the brand in relation to

other purchasing factors. Role of Brand Index (RBI) takes this portion as a percentage and is calculated based on primary research, historic overview of the firms operating in the same industry and valuation done by experts. After RBI is calculated, it is then multiplied by economic profit from the financial analysis in order to identify brand earnings. (Interbrand, 2014e)

The last analysis item is competitive or brand strength analysis. This part of the analysis measures the ability of brand to generate profit in the future and is conducted by using 10 internal (clarity, commitment, protection and responsiveness) and external factors (authenticity, relevance, differentiation, consistency, presence and understanding) (Rocha, 2014b; Interbrand, 2014f). Brand strength is assessed on the scale from 0 to 100 based on the comparison with the brands within the same sector and other world top brands. (Interbrand, 2014e) Strength Score of the brand (BSS) is linked to the discount factor in order to bring future brand earnings to the net present value (Lindmann, 2010).

3.3.3. Interbrand's top high-technology companies

The current research has high-technology companies in the focus. There have been identified 36 high-technology companies based on the theory review and index created (chapter 2.1.2). This sub-chapter describes shortly the companies selected for the analysis.

There are 17 sectors of industry of participating companies in 2013. Figure 6 gives an overview of the top best global brands by segments.

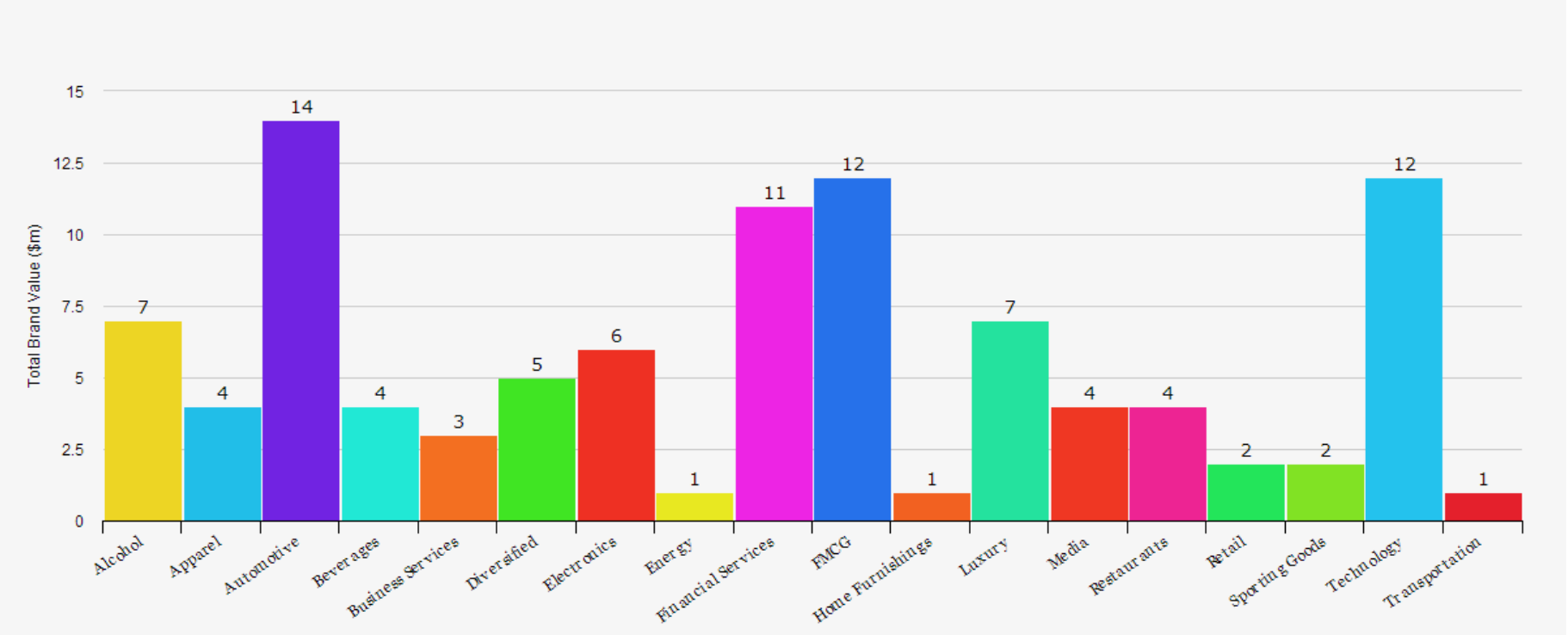

Figure 6. Best Global Brands by sector in 2013 (Interbrand, 2014g).

The figure above clearly shows four leading sectors, two of them being of high-technology sector based on the above-created high-technology index and OECD classification (Loschky, 2010): automotive industry (14 companies) and technology (12 companies). High-technology companies selected for the current study are further described in detail by sector.

Automotive industry

The automotive industry brands in 2013 included 14 brands. 11 brands with six repeat ratings from 2008 to 2013 from automotive industry in 2013 are included into the present study and include Audi, BMW, Ferrari, Ford, Harley-Davidson, Honda, Hyundai, Mercedes-Benz, Porsche, Toyota and Volkswagen.

The highest brand value from the automotive sector is gained by Toyota – $35,346 million. All of the brands in the automotive industry showed increase in value from 2012 to 2013 (Table 8). The brands should catch up with the industry trends and take into consideration market differences. For the moment innovation, adaptation to the customers' needs and sustainability issues are the key for the automotive industry. Today's successful and highly valued automotive brands should respond to the consumers' needs with shifting population, life-style and perceptions trends. (Interbrand, 2014h)

Table 8. Best automotive brands in 2013 (11 selected for the research) (Interbrand, 2014h).

Rank	Brand name	Brand value ($m)	Change in brand value
10	Toyota	35,346	17%
11	Mercedes-Benz	31,904	6%
12	BMW	31,839	10%
20	Honda	18,490	7%
34	Volkswagen	11,120	20%
42	Ford	9,181	15%
43	Hyundai	9,004	20%
51	Audi	7,767	8%
64	Porsche	6,471	26%
96	Harley-Davidson	4,230	10%
98	Ferrari	4,013	6%

Business services

Limitedly presented in Interbrand rating, business services sector includes three companies as top global best brands in 2013. Two of them, have been defined as high-technology firms and have six repeat rankings from 2008 to 2013: IBM and Xerox. Both brands – IBM and Xerox – showed positive brand value growth in 2013: 4% and 1% respectively. However, the pace of brand value growth is slower than in automotive industry. Interbrand consultancy notes important issues for business services sector, including behavioral mindset, intellectual property and knowledge. (Interbrand, 2014h)

Diversified

Among five diversified companies, included into Interbrand ranking in 2013, three have been selected for the current study: Caterpillar, GE and Siemens. Their brand values are calculated to be $7,125 million, $46,947 million and $8,503 million respectively, where GE has a clearly leading position. (Interbrand, 2014h)

Electronics

In 2013 Interbrand ranked six companies from electronics sector as best global brands. All of them have been defined as high-technology companies in the present study and have shown stable enough high brand value during the last six years. Nevertheless, four out of six companies in electronics sector lost their brand value from 2012 to 2013. Thus, Sony lost 8%, Canon 9% and Nintendo 14%. But the highest loss of 65% was shown by Nokia brand, which is linked to the latest performance of the brand and events accompanying it.

Fast moving consumer goods (FMCG)

Out of 100 best global brands 12 are coming from FMCG sector. According to the criteria set in the high-technology index, two out of 12 can be defined as high-technology companies: Johnson & Johnson and L'Oreal. These companies make significant investments in R&D – 11.5% and 3.7% from companies' sales (Table 7).

Retail

Retail industry in Interbrand top 100 listing is represented by two companies – Amazon and Ebay. These two companies have been classified by created index as high-technology sector based on their R&D expenditures and industry, they are operating in. Both brands have shown a formidable growth in value in the last year: Amazon of 27% and Ebay of 20% (Interbrand, 2014h).

Technology

Technology sector along with automotive industry is the industry, which is a priori considered high-technology. For the present study 10 brands out of 12 from Interbrand rating in 2013 have been selected and include the following names: Apple, Cisco, Dell, Google, HP, Intel, Microsoft, Oracle, Samsung and SAP. While most of them have positive growth in value, three brands stand out: Google with increase of 34% in brand value in 2013, Apple with 28% and Samsung with 20% (Interbrand, 2013).

3.4. Alternative approaches and indices to assess brand value

For the present study the rating done by Interbrand consultancy using its brand valuation approach is used. On the other hand there are different methods used by other companies and researches for calculation brand

value. Some of them will be discussed in more detail in the following sub-chapters.

3.4.1. BrandZ

Brand management tool BrandZ has been developed by the company Millward Brown, whose main focus is at brands, media, advertising and communication (Millward Brown, 2014a). Established in 1973, Millward Brown has currently a wide world presence experience and participation in different areas and projects (Millward Brown, 2014b).

BrandZ ranking of top 100 most valuable global brands has been published by Millward Brown during the last 8 years (Millward Brown, 2014c). Brand value calculated by Millward Brown differs from the value generated by Interbrand. The comparison of values of the brands, selected for the current study, is presented in Appendix 4. As it can be seen from the table in Appendix 4 brand values of selected 36 companies differ significantly. Moreover, 16 high-technology brands, being in top 100 in Interbrand ranking are not included in BrandZ listing. This gives an understanding how delicate is the issue of brand calculation and how various methods give differing values.

While Millward Brown uses “economic use” approach as well as Interbrand, their methodology does differ, which can be seen from the comparison table. BrandZ research starts with interviewing consumers about brands, covering 2 million customers around the world (Lindemann, 2010, 29; Millward Brown, 2014d). Thus, the stage of screening the brands differs from the method used by Interbrand.

After conducting interviews, valuation process starts. First, financial value of a brand is calculated. By multiplying corporate earnings by the attribution rate (rate generated as a result of financial analysis of the corporation and brand’s portion of generated earnings), Willward Brown

gives branded earnings. Along with branded earnings, Brand Multiple is calculated, which is used for predicting future revenues. Multiplication of Brand Multiple and branded earnings gives Financial Value (Millward Brown, 2014d).

Next part of brand valuation includes calculation of Brand Contribution, meaning excluding such factors as convenience, price, distribution, etc. Brand Contribution gives understanding of brand's uniqueness and ability to generate customer loyalty. Brand Contribution is further multiplied by Financial Value, where the result is brand value (Lindemann, 2010, 31; Millward Brown, 2014d).

3.4.2. Brand Recall Index (BRI)

An alternative for brand valuation, but still assessing a brand is Brand Recall Index (BRI) (Krishnan, Sullivan, Groza & Aurand, 2013). It can be easily implemented and does not require sophisticated data collection and analysis. While, big companies can afford brand valuation done by such consultancies as Interbrand or BrandZ, the method of BRI can be used by any company for any customer group as often as needed.

Brand Recall Index is calculated according to the following algorithm. The participants are asked to recall as many brand names (possibly in a given industry) as they can during five minutes. The order of recall in noted as well. After collecting the data BRI for a brand j is calculated as following:

$$BRI_{BRANDj} = \left[\frac{100}{N}\right] \sum_{i=1}^{N} \left[\frac{1}{RANKij}\right] \quad (1)$$

Where,
N – number of respondents.
RANKij – the rank given to the j^{th} brand by the i^{th} respondent.

As a result for each respondent each brand is given a weight, which is an inverse fraction of the rank order. The brand's weights are then summed using all respondents' answers. (Krishnan, Sullivan, Groza & Aurand, 2013)

Past research studied brand recall by investigating brand names considering words and non-words names, relevant and irrelevant names, cues of advertised and unadvertised attributes (Lerman & Garbarino, 2002). Importance of brand recall for brands and brand equity has been noted (Aaker & McLoughlin, 2010): if brands are not recalled by the customers, brands are not competitive. High recognition of brands is not enough - brands should be recalled in order to gain part of the market. Furthermore, higher brand recall is associated with high-involvement products (Radder & Huang, 2008), as the customers get connected more with some particular product categories.

There is a great deal of approaches to define brand value. Some are more sophisticated, others can be used by any firm independent of size and resources. Thus, Raggio and Leone (2007a) suggest using sale price of a brand as a measure of brand value. While many researchers define and measure brand value according to their approaches, three main groups of brand valuation methods exist, including marketing, financial and blended approaches (Lindemann, 2010, 21-22). The present study discusses brands and brand values measured according to Interbrand methodology, which is a blended marketing-financial approach.

4. LONG-TERM BRAND DEVELOPMENT STRATEGIES

This chapter covers brand development strategies used by the companies to increase brand value. The purpose of the chapter is to give an overview of the previous research done on brand development strategies with a special focus on long-term strategies.

As mentioned earlier, brand development strategies fall in two categories: short-term and long-term. The former bring the immediate results, where immediate results are seen as weekly by Mela, Gupta and Lehmann (1997). On the contrary another set of brand development strategies – long-term strategies – bring time-lagged results, which will be seen in the future. These strategies influence the consumers, they choice of brands and attitudes over years. (Mela, Gupta & Lehmann, 1997; Pauwels, 2004) Long-term brand development strategies are the focus of the current study and are further discussed in detail in the current section.

Long-term brand development strategies bring lagged results and impact the brand in the distant future. Same kind of definitions has been given by several researchers. Thus, Mela, Gupta and Lehmann (1997) in their studies defined long-term effects as a cumulative effect on the brand choice that the consumers make and which lasts over several years. Important here is the notion of time – “several years”. Similar idea of time in regard to long-term effect or strategies was expressed by Mela, Ataman and Heerde (2006), who defined long-term results as the effect of marketing on consumers, who are leavened to marketing over several quarters or years. In such a way, while short-term strategies show the results visible in several weeks, long-term brand development strategies are of distantly-planned nature and often benefit not the implementor, but his successor.

Based on the decisive effect of time in regard to long-term brand development strategies the current research studies their effect on brand

value of the selected 36 companies during the period of six years – the impact of long-term brand development strategies will be measure with the time lag of six years.

There is no one single opinion among the researchers which strategies are to be considered as bringing long-term effects. Nevertheless, there are some repetitive conclusions. Mela, Ataman and Heerde (2006) studied marketing mix in their research and the effect of each of the elements on brand value. And proving other research findings promotion resulted having no long-term impact on brands. On the other hand other dimensions of marketing mix showed leveraging effect on the brands, especially elements associated with product side. Thus, having an extensive product variety has been found out to increase quantity and price premiums. Complementing to the notion of importance of the aspects related to product, Pauwels et al. (2004) showed the importance of new product introductions in a long run by investigating automobile industry over a period of time.

On the other hand, Mela, Gupta and Lehmann (1997) studied long-term effects of advertising and promotion only. Their results showed the positive influence of advertising on consumers and their mindset by making them less price-sensitive and reducing the non-loyal customer group. These effects can be seen as prerequisites for generating brand value (based on the brand value chain).

Slightly different set of strategies were examined by Chu and Keh (2006). They studied lagged effect of advertising, R&D and promotions on brand value of the companies. The authors found different thresholds of needed investments in these strategies to bring the best possible results. Important notion made by Chu and Keh is that the influence of these three strategies depends on such aspects as country of base and the type of industry. That is why the current research is important for observing the

effect of the brand development strategies only in the frames of one single industry.

As a part of the product side design is not usually studied along with other marketing mix elements. Being rather a standout design and its effects are often examined separately. Montaña, Guzmàn and Moll (2007) emphasized the importance of design in all stages of brand building and the necessity of design to be linked to NPD process from the beginning. Similar opinion was expressed by Jan Hall (1993), who explained the importance of design in relation to brand extension, new brand development and internationalization.

Shortly-observed above literature shows the importance of several brand development strategies in the long-run. These strategies tend to bring lagged results for the brands. This research concentrates on advertising and four elements of product dimension – R&D, innovations, NPD and design. These five long-term brand development strategies are further discusses in details.

4.1. Advertising

Advertising has been admitted by many researchers as having a long-lasting effect on brands and their value. This element along with promotion is the most studied one of whole marketing mix (Table 1). Many researchers have studied the impact of advertising on a firm value, brand and financial outcomes.

The importance of advertising as a long-term brand development strategy has been already mentioned above. Table 1 shows that many researchers have paid attention to this particular element in relation to its effect on brand sales, choice, market structure, quantity and market share (Clarke, 1976; Dekimpe & Hanssens, 1995; Mela, Gupta & Lehmann, 1997; Mela, Gupta & Jedidi, 1998; Jedidi, Mela & Gupta, 1999; Pauwels, 2004; etc.).

These and other researchers explained the effect of advertising. Thus, Mela, Ataman and Heerde (2006) concluded in their study based on 5-year data that advertising is one of the key issues in building the brands in the long-run. Advertising showed particular effect on quantity premiums comparing to product and distribution investments.

Another research on advertising was conducted by Mela, Gupta and Lehmann (1997). This study used 8 ¼ years data to examine the impact of advertising on long-term brand choice behavior of the customers. The results showed that advertising decreases price sensitivity over time and decrease non-loyal customer group. Similar research was done by Jedidi, Mela and Gupta (1999), who showed a positive effect of advertising on brand equity. While supporting previous studies this research did not find significant support on whether advertising decreases price sensitivity from consumers' side.

Consistent conclusions regarding the long-term effect of advertising have been made by Chu and Keh (2006), who analyzed six years of data on 73 brands. The authors indicated a positive influence of advertising on brand value and provided the most optimal advertising expenditure budget – spending between $200 million and $4.6 billion resulted to be the most effective, while low levels of advertising are not beneficial to brand building.

Based on the above discussion the following hypothesis is proposed:

H1. Advertising has a positive effect on brand value of high-technology companies in the long run.

4.2. R&D investments and R&D intensity

There has been not much research done on influence of a product side of a marketing mix on brands and their value. R&D investments and R&D

intensity are often associated with product improvement and developments. R&D investments are considered essential and are necessary to complementary good advertising and promotion (Chu & Keh, 2006). Keller (2000) also pointed out the importance of R&D support for the brand development along with prerequisites.

Limited research has shown that brands can benefit from R&D investments in several ways. Thus, brand extensions have been reported to gain positive results from R&D spendings in several cases (Ambler & Styles, 1997). R&D was noted to be one of the most important functions along with marketing in brand development. Furthermore, Jeong (2004, 17) noted in his research positive effect of R&D on brand equity. He stated that this effect is reached with the help of R&D by leveraging *"… firm's intellectual market-based assets",* which help a company to compete against other firms on the market. If comparing the impact of R&D and advertising on brand equity, Jeong found that R&D investments are more effective to contribute to a company's brand equity than advertising spendings.

Chu and Keh (2006) analyzed the impact of R&D on brand value of the selected companies in the long run. The results showed that R&D expenses bring higher returns when being at below $200 million. On the other hand R&D spending up to $1 billion does not increase brand value significantly and reaches its maximum effect at this figure. Furthermore, Ho, Keh and Ong (2005) examined the effect of R&D investments on firm's value. The study's results showed that extensive R&D expenditures lead to positive one-year stock market performances for manufacturing firms, while bringing opposite effect to non-manufacturing companies. These studies examined absolute value of R&D expenditures. While giving an understanding of company's spendings on R&D, this value might be analyzed in relation to company's sales – R&D intensity.

R&D intensity is often used to measure company's innovative activity and is defined as the ratio of a company's R&D expenditures to company's revenue (Chao & Kavadias, 2013). It is important to measure R&D intensity since it gives an idea of a company's dedication to R&D initiatives. Andras and Srinivasan (2003) analyzed the impact of R&D intensity on company's profit margins in comparison to advertising intensity. The results of their study showed that manufacturing product organizations, which high-technology companies usually are, have high R&D intensity. The researchers also emphasized that investing in intangible assets, including R&D, while showing negative effect on short-term profit brings long-term results.

R&D expenditures (absolute or relative to sales value) is one of the several antecedents, strengthening the brand. By providing a firm with necessary information and knowledge about the market and competitors, R&D supports brand equity of a company. (Jeong, 2004) Therefore, the relationship between R&D and brand value is hypothesized as follows:

H2. R&D expenditures have a positive effect on brand value of high-technology companies in the long run.

H3. R&D intensity has a positive effect on brand value of high-technology companies in the long run.

4.3. New product development (NPD)

While company's innovativeness can be measured using R&D expenditures numbers, it can be also assessed looking at new product development process. NPD is agreed by many researchers to be an important competitive factor, leading company to success (Schilling & Hill, 1998). NPD is especially essential for high-technology companies, who highly depend on introducing new products to the market, where the competition is often based on product performance and specificaitons.

In terms of the effect of NPD, some research has been done in this direction. Thus, Pauwels (2004) analyzed along with other dimensions the effect of product-line extensions and showed that the effect from introducing new products to the market might be visible after some time lag. Another research investigating the influence of NPD was conducted by Pauwels et al. (2004), who found that new product introductions lead to better financial performance of a company and increased company value in the long run. The researchers investigated the automobile industry companies to see the impact of new products development on top-line, bottom-line and stock market performance. The research showed that NPD resulted in tens of millions of dollars in the long-term and was stated by the authors to be *"…an important component in determining its long-term impact on firm value"* (Pauwels et al. 2004, 154). Similar conclusions were made by Heerde, Mela and Manchanda (2004), who stated the importance of innovation and innovation products for the companies. The researchers studied the effect that an innovative product brings to a non-evolving product category.

Furthermore, Mela, Ataman and Heerde (2006) while studying the long-term influence of a marketing mix on brand performance, concluded with beneficial effect brought by product innovations. The results of their research demonstrated product variety to lead to quantity and margin premiums (the latest is achieved by decreasing price sensitivity). While, seeing the results of innovation and new product development might take years, investing in these long-term strategies is advisable to leverage overall brand performance and value.

Aaker and Jacobson (2001) in his study of brand attitude, which is one of the main elements of brand equity, found that for high-technology companies new products lead to increased brand attitude and as a result increase brand equity. Thus introduction of new products can shape brand attitude, which is especially relevant for high-technology market.

The above discussion leads to the following hypothesis proposition:

H4. New product development has a positive effect on brand value of high-technology companies in the long run.

4.4. Design

Being an important product element and factor, design is seldom studied together with other elements as brand influencer. Design has been agreed by many researchers to play an essential role in a firm's competitiveness, product development and brand building (Walsh, Roy & Bruce, 1998; Hall, 1993; Borja de Mozota, 2003).

The importance of design in brand building and differentiating from the competitors has been noted by Montaña, Guzmàn and Moll (2007). The authors concentrate on the fact that consumers buy brands, not products, since often products own same features and characteristics and their performance is almost identical. But a brand allows a company to differentiate from the competitors and bring the meaning to the customers. Many brand elements are led by design, which should, as described by the researchers, be "proactive" and highly coordinated.

These and other researchers emphasize the need to integrate design and brand management, because of the high influence of the former on the latter. Beverland (2005) studied the relationship between design and brand management by looking at luxury wine industry. The results of the research were five methods of integrating design into a firm and brand management. Another research was done by Stompff (2003) on the connection between design and brand and how the right design can communicate the brand values to the consumers. The author showed using a case company how brand values can be shown through the design of a product and how the brand can be influenced by the design in

such a way. For demonstrating how products and their design can influence brands, Stompff uses a framework by Desmet (2002) (Figure 7).

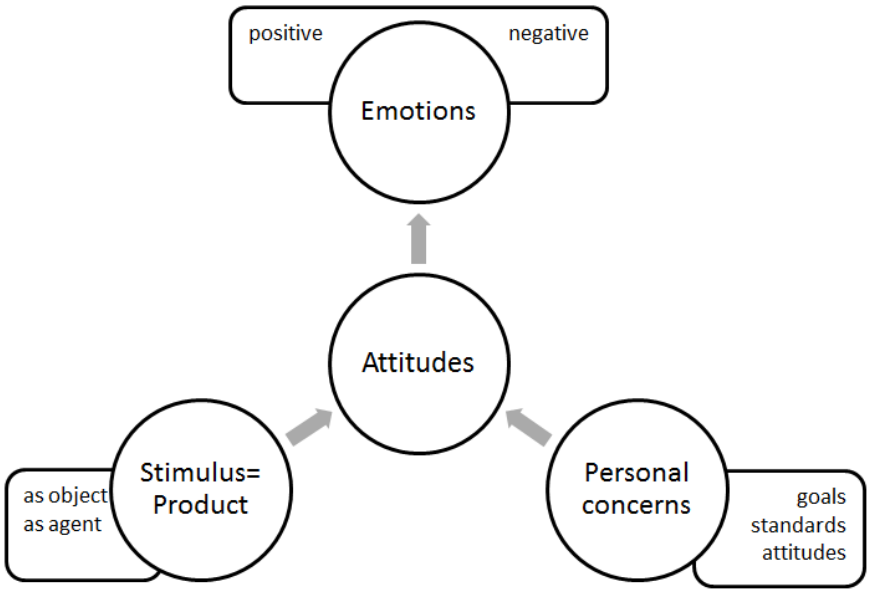

Figure 7. Product contribution to a brand image (Stompff, 2003; Desmet, 2002).

Products and design elements of the products can influence brands of the products by raising some emotions, which in their turn influence the attitude of the consumers toward specific brands. Brand attitudes shape the customer mindset, which is a part of a brand value chain (Keller & Lehmann, 2003).

The influence of design has been also shown by Kreuzbauer and Malter (2005). The research has demonstrated that attractive design of a product provokes beneficial evaluation of a brand and allows brand categorization. Nevertheless, more attention should be paid to the relationship between design and brand management and marketing (Svengren Holm & Johansson, 2005).

Though, some research on link between design and brand has been conducted (Walsh, Roy & Bruce, 1998; Hall, 1993; Borja de Mozota, 2003; Montaña, Guzmàn & Moll, 2007; Beverland, 2005; Stompff, 2003;

Kreuzbauer & Malter, 2005), the research is limited and no research has been done on the influence of design on economical brand value. Based on the previously conducted research there are grounds for assuming long-term effect of design on brand value. However, taking into consideration the structure of the current research and means of its accomplishment, it seems unfeasible to measure specifically long-term effect of this strategy. Nevertheless, built on the previous literature, design is considered an important strategy for brand value generation and should be taken into account. Therefore, the above discussion can be summarized by the following hypothesis proposition:

H5. Design has a positive effect on brand value of high-technology companies.

4.5. Summary of the hypotheses

In chapter 2 the theory of brand value, brand value creation and brand development strategies has been discussed. The distinction between two types of brand development strategies – short-term and long-term – has been made. Long-term brand development strategies, being at focus in the current study, namely advertising, R&D investments and R&D intensity, new product development (NPD) and design, have been presented in detail. Based on the theory review, hypotheses have been proposed. The summary of the research hypotheses is presented in Table 9.

Table 9. The summary of the research hypotheses.

H1	Advertising has a positive effect on brand value of high-technology companies in the long run.
H2	R&D expenditures have a positive effect on brand value of high-technology companies in the long run.
H3	R&D intensity has a positive effect on brand value of high-technology companies in the long run.
H4	New product development has a positive effect on brand value of high-technology companies in the long run.
H5	Design has a positive effect on brand value of high-technology companies.

Based on the theory and hypotheses propositions made, the research framework has been built and is presented in Figure 8. The figure shows causes and relationships between the variables.

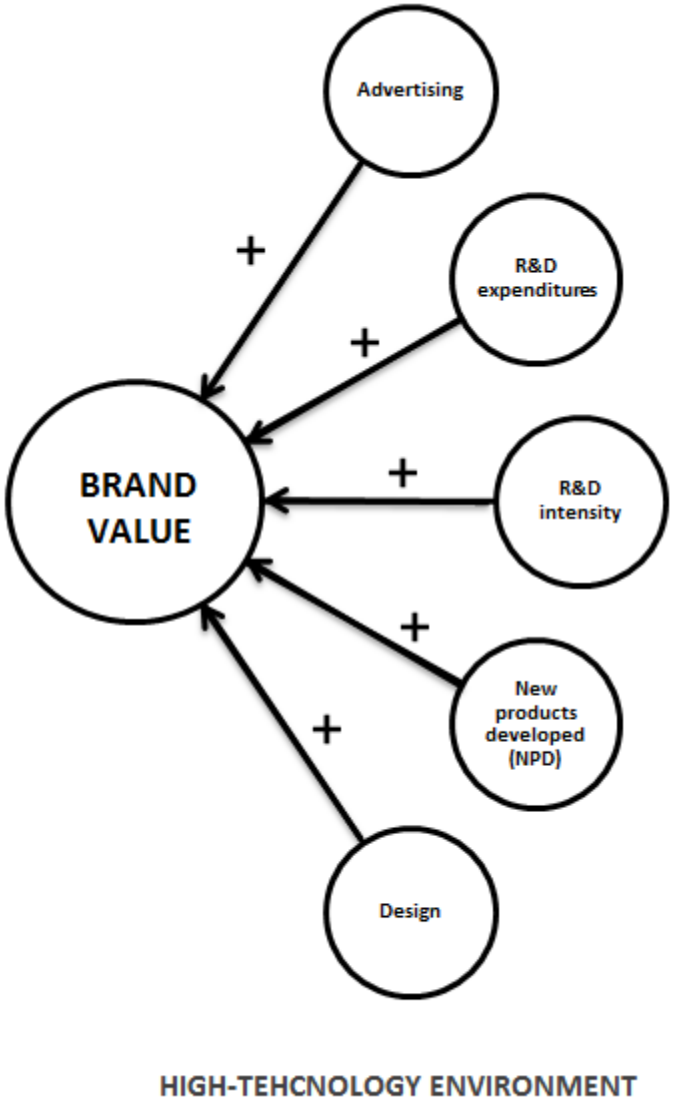

Figure 8. Theoretical framework and research hypotheses.

5. RESEARCH METHODOLOGY

This chapter relates to the empirical part of the study. First research method and data collection will be described, followed by the description of questionnaire design and questionnaire pretesting. These sub-chapters are followed by the section with the focus on sample and sampling technique, used for collecting the primary data. Then control variables for the variable *design* will be described. The chapter ends with explanation of secondary data collection and data coding.

5.1. Research method and data collection

The current study uses quantitative method for the empirical analysis. Quantitative method has been chosen for the present research since it allows accomplishing the objectives of the study in a best possible way. Quantitative research has been chosen to use for testing hypotheses. Nevertheless, a study does not have to be limited by usage of either quantitative or qualitative method – both approaches can be used and complement each other (Render, Stair Jr. & Hanna, 2003).

The research is of positive character, which is aiming at describing, explaining and deepening understanding of existing marketing phenomena and issues (Hunt, 2002, 12-14). On the other hand, Hyman, Skipper and Tansey (1991) evaluated marketing as mostly normative phenomena, thus leaving no space for positive marketing issues and topics. Nevertheless, following Hunt's explanation, positive theory is differentiated from normative in three ways. Firstly, positive theory is similar to lawlike generalizations, which are aimed at explaining processes, while normative theory is of prescriptive nature. Second, positive and normative theories serve different purposes. While positive theory's goal is to leverage understanding and help in decision making, normative theory gives specific rules to follow. And the last difference is in validation criteria. Positive theory and models can be verified by testing hypotheses in real

world. On the other hand, normative research cannot be tested. The current research endeavors to discover what long-term brand development strategies high-technology companies should use in order to leverage their brand value in order to help the companies make right decisions. These explanations will be made based on the research conducted.

As set earlier 36 high-technology companies from Interbrand Top 100 ranking will be analyzed. The following data for the last six years from 2008 to 2013 will be collected: R&D expenditures, sales, advertising expenditures, new products developed. For testing the hypotheses both secondary and primary data will be collected. Hypotheses H1, H2, H3 and H4 will be analyzed using the data from the secondary sources: selected companies' annual reports (for H1, H2 and H3) and Espacenet Patent Search (for H4) (Espacenet, 2014). Hypothesis H5 will be tested using data from primary sources by distributing the questionnaire related to the design perceptions on selected 36 brands.

5.2. Primary data collection

A questionnaire has been used to collect the data for testing the hypothesis H5 - Design has a positive effect on brand value of high-technology companies in the long run. As a tool a web-based survey has been used for collecting the data. This method has been chosen due to several reasons. Self-administrated web-based surveys allow covering wider geographic area and reaching bigger respondent group (Bourque & Fielder, 2003, 10-12; Parasuraman, Grewal & Krishnan, 2007, 158-159).

The survey contained several parts relating to different data to be collected. The questionnaire has been structured as following:

1. Background information.
2. Familiarity with the brands.

3. Grading of the design characteristics (for each of the studied brands individually).
4. Contact information (optional).

For the questionnaire several types of questions have been used, including dichotomous and multiple-category structured questions and non-structured open questions (Parasuraman, Grewal & Krishnan, 2007, 283-286). For obtaining the background information multiple-choice and open questions have been used. For assessing respondents' familiarity with the studied brands, category scale (Fink & Kosecoff, 1985) has been created. The respondents could assess their familiarity with the brands by rating it as the following: "not at all familiar", "slightly familiar", "moderately familiar", "very familiar" and "extremely familiar".

The questions referring to grading of the design characteristics 6-point Likert scale has been used, which was complemented with a response choice "I am not familiar with the brand". Each brand used its own rating scale by measuring several design and general brand characteristics. The last question of contact information was optional and used open questions. The questionnaire is reported in Appendix 5. The items, forming the questionnaire, are further discussed in detail.

Background information

Since the questionnaire was distributed via the Internet, there was little control over the sample. Collecting respondents' background information allows analyzing the sample, cross-classifying the responses (Parasuraman, Grewal & Krishnan, 2007, 299) and includes the questions of respondents' gender, age and nationality. Background information of the respondents, namely age and gender, has also been used as control variables to see if gender, age and nationality affect the respondents' evaluation of the products' design.

Familiarity with the brands

The question related to familiarity with the brands assesses how well respondents know the brand according to their own judgment. This question aids to analyze respondents' answers taking the degree of their familiarity with the brand into account. Respondents' familiarity with the brands has been used as a control variable for revealing its impact on evaluation of the design.

Design characteristics grading

The hypothesis H5 has been tested using the primary data collected. In choosing relevant measures for assessing design perceptions of the respondents previously conducted research has been used. Hertenstein, Platt and Veryzer (2005) propose a model of how industrial design is related to NPD process and how the latest affect financial performance of the companies. Successfully implemented industrial design, which belongs to corporate inputs, should be visible through the following outputs:

1. From the customer viewpoint: increased utility (beyond functions) and aesthetics/appearance.
2. From the point of view of other inner parties in the company: manufacturability, product function and equipment expenditures.

This study concentrates on assessing customers' perceptions of the design. Thus, the measures related to the customer viewpoint are suitable. Similar and other measures of design were suggested by Hertenstein and Platt (2000) and used in other research (Jonkka, 2012). Two big groups of measures were used: financial and non-financial measures. The latter group is suitable for the purposes of the current study and includes the following sub-categories: timing, design effectiveness, design efficiency, customer satisfaction, employee-rated, strategic, innovation and volume. Since, this research concentrates on customer viewpoint; two measures

from customer satisfaction category can be used for its purposes: ease of use, style/appearance and product satisfaction.

Furthermore, design of the selected companies was assessed using Walsh, Roy and Bruce (1988) model of customer viewpoints at different phases of product purchase and usage. There are different elements at which design implementation can be seen. Those elements are distributed across four phases (Table 10).

Table 10. Product design factors at different phases of purchase and usage (Walsh, Roy & Bruce, 1988).

Phase	**Product design factors**
Before purchase	Manufacturer's specification, advertised performance and appearance, test results, image of company's products, list price.
Purchase	Overall design and quality, special features, materials, colour, finish, first impressions of performance, purchase price.
Initial use	Actual performance, ease of use, safety, etc.
Long-term use	Reliability, ease of maintenance, durability, running cost, etc.

For fulfilling the purposes of the current studies the following measures have been considered: product performance, appearance, materials, finish, reliability, durability, safety and ease of use.

Though, all of the selected measures would provide valuable insight on design from the customer viewpoint, only a few of them have been selected for the actual survey running. The measures used to assess the design in the questionnaire include the following:

1. Aesthetics
2. Ease of use
3. Reliability

4. Safety
5. Overall product satisfaction.

The question relating to the design also included two more measures: overall importance of design for a company and overall brand value. The former measure helps to assess the input of design into brand value in relation to its importance for a particular brand. The latter will be used to analyze and compare brand value calculated by Interbrand and brand value as perceived by the respondents.

5.2.1. Questionnaire pretesting

Pretesting the questionnaire allowed to check that the information collected correspond to the survey purposes and detect any survey design misunderstanding (Parasuraman, Grewal & Krishnan, 2007, 304). Moreover, pilot running of a questionnaire gives the possibility to check the time needed to fill the questionnaire and to make adjustments if needed. The questionnaire pretesting was done in the form of face-to-face interviews with 3 randomly selected respondents. Pilot survey funning allowed tracking respondents' understanding of the questions and difficulties encountered while responding.

Pretesting the questionnaire also has revealed some factors influencing the respondents' specific grading given to each brand. Thus, the respondents often relied on their experience of owning or even more often of trying a product. Even more important, that customer loyalty and long company-customer history positively influenced the respondents' opinion about a brand despite encountering the problems. On the other hand the opinion of the respondents about the products' design was sometimes formed only due to one or several key products, offered by the brand. Thus, one of the respondents associated Johnson-Johnson only with skin-care products.

Pilot surveys also allowed seeing that the brands serving some narrow segments (such as Porsche) caused some difficulties from the respondents' side to evaluate the brand design fully, since they have not tried the product. However they had high awareness about the brand due to the rumors and information available.

5.2.2. Description of sample and sampling techniques

After being completed the questionnaire was distributed to the respondents via non-probability snowball sampling (Babbie, 2014, 200-201). Originally the questionnaire was published in several social networks' webpages and sent to the students of Master Degree Programme in International Marketing Management in Lappeenranta University of Technology. Initial sample included Master's Degree students in Finland and France. The respondents taking the survey at the beginning were used to identify other respondents with similar to them characteristics and to distribute the questionnaire further. The survey was a web-based questionnaire and generated 102 responses, from which 84 were used in the research. Questionnaire was open in the Internet for 25 days and the respondents were motivated to reply by having a possibility to win one of appreciative prizes.

5.2.3. Control variables for "design" variable

The control variables in the current study have been chosen to test if they have any impact on the respondents' answers related to design. The control variables in the current research are not hypothesized, however based on previous studies they are predicted to have an effect. The control variables used in the present study include *familiarity with the brand, age* and *gender.*

The first control variable - *familiarity with the brand* – is expected to influence the grades, which respondents gave to the selected brands'

design. Previous research (Dacin & Smith, 1994; Sujan 1985) has shown that consumers' preceding knowledge about the products affects their evaluation of the products. Moreover, some research proposes that the more familiar customers are with a product and the more knowledge they have about it – the more favorably they evaluate a product/ brand (Hong & Sternthal, 2010). It is expected that the same effect can be observed in relation to the familiarity of the customers with a brand and their evaluation of brand's design.

Similarly to the first control variable respondents' background is expected to form the evaluation of the companies' design. Background control variables incorporate *age* and *gender.* The influence of age and gender on perceived quality, value and satisfaction has been studied by Sharma, Chen and Luk (2012). The study found the differences in these and other dimensions for different respondents groups based on age and gender. However, another research (Blijlevens, Creusen & Schoormans, 2009), studying consumer perceptions of product appearance, has not revealed any differences across different age and gender groups.

5.3. Secondary data collection

For testing the hypotheses H1, H2, H3 and H4 secondary data has been collected. For assessing innovation the number of new product developed has been taken as a measure (Pauwels et al., 2004) and was obtained from Espacenet Patent Search (Espacenet, 2014) as a number of patent registered on the name of a specific company for a specific year.

Advertising expenditures have been taken from the companies' annual reports. Because of the differences in the reporting advertising investments include different items:

- Apple: selling, general and administrative expenses.
- Google: sales and marketing.
- IBM: advertising and promotional expenses.

- Cisco: sales and marketing.
- Oracle: sales and marketing.
- Audi: is part of distribution costs.
- Xerox: sales, administrative and general expenses.

Moreover, not all the companies report advertising expenses. Thus, General Electric, Mercedes-Benz, Honda and SAP do not include advertising expenses or report them within other costs. For Ebay no advertising costs reported, while there are sales and marketing expenditures in the annual reports and which are used as advertising expenditures for the current research. Similar, for Hyundai, Nokia, Dell and Siemens advertising costs have been taken as selling, administrative and general/ marketing costs. Furthermore, BMW reported advertising costs together with marketing and sales personnel costs in 2008, 2009, 2010 and 2011 and within sales and administrative expenses in 2012 and 2012.

Similarly to advertising, R&D expenditures might include different items in different companies' reports. Amazon does not report R&D expenditures, while providing technology and content expenses instead, which have been used as R&D expenditures for the purposes of the study. Similarly, Ebay provides product development costs numbers.

For Porsche brand, which is a part of Volkswagen group and which represents 7.29% of Volkswagen sales, the numbers have been taken as 7.29% of Volkswagen investments in R&D and advertising.

Furthermore, since companies of the studied brands report in different currencies, all the numbers have been recalculated into USD. The exchange rates used for reducing the numbers to USD were taken either from the companies' annual reports if reported or from the annual exchange rates provided by Bank of Finland and Board of Governors of the Federal Reserve System in the USA. The table with exchange rates used is resided in Appendix 6.

5.4. Data coding

Collected primary and secondary data was coded and analyzed using Stata 11 software and SPSS (Statistical Package for the Social Sciences) software (SPSS 21). Each studied company was given an ID number, while the time periods were marked from 0 to 5, where 0 is the first time period in the research (2008) and 5 is the last time period (2013). The cases with missing values were utilized in the research. Variables *advertising investments, R&D investments, NPD* and *brand value* were coded as numeric values for each time observation of a single company. The variable *R&D intensity* is a ratio of a company's R&D investments to total sales and was coded in SPSS software as a comma type variable and as numeric variables in Stata. The variable *design* was obtained from primary data based on respondents' brands' evaluation on the scale from 0 to 5 and in distinction from other variables is time-invariant.

6. RESEARCH ANALYSIS AND RESULTS

In this part the results of the research will be reviewed and analyzed. First, the primary and secondary data will be discussed, including sample description, assessment of respondents' familiarity with the brands and character of changes of independent variables. In the second half of the chapter, data analysis will be presented, starting with the method applied – panel data analysis, fixed effect model – and the results obtained.

6.1. Primary data

6.1.1. Sample description

Totally 84 surveys responses were used for data analysis. Most of the respondents (51.2 %) fell into the age group 25-29 year old. This group is followed by other age groups accordingly: 18-24 year old (28.6 %), 35-44 year old (8.3 %), 30-34 year old (7.1 %), 45-54 year old (3.6 %) and 65+ year old (1.2 %). High numbers of respondents in groups 25-29 year old and 18-24 year old are explained by initial distribution of the questionnaire to the students. Figure 9 presents the distribution of respondents' age in both genders.

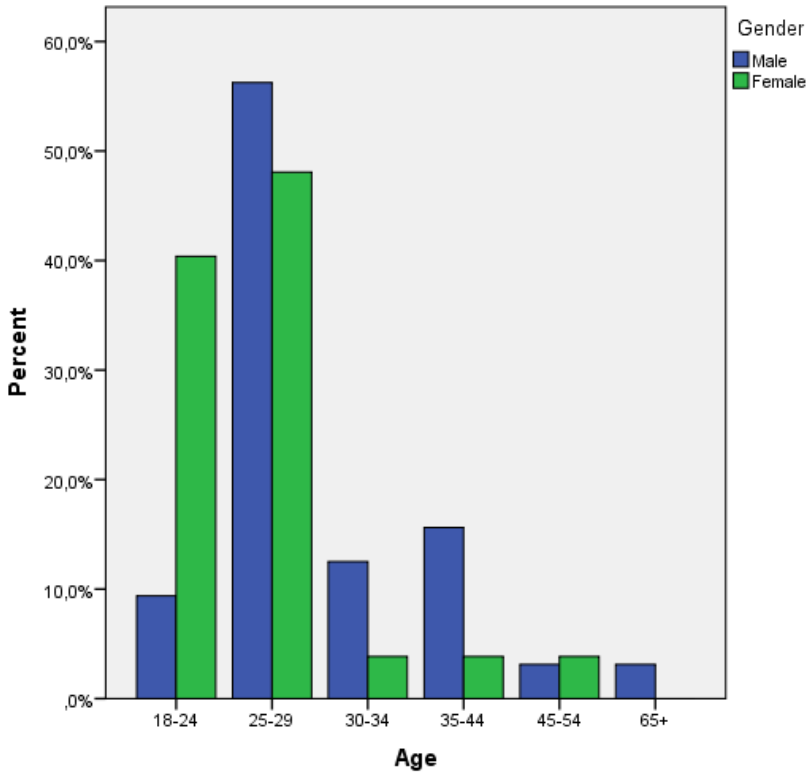

Figure 9. Age distribution.

As derived from the figure above 38.1 % of the respondents included men, while female respondents constituted 61.9 %. The prevailing number of female respondents has been observed also during the previously conducted research (Sax, Gilmartin & Bryant, 2003), where women showed more willingness to respond to both web-based and paper surveys.

Figure 10 indicates the nationality of the respondents participating in the questionnaire. As it can be seen most of the respondents are of Finnish nationality (38.1 %), followed by Russian nationality (21.4 %) and then French (6.0 %). The distribution of nationalities might be explained by the initial placement of the questionnaire, which was first visible to the students in Finland and France.

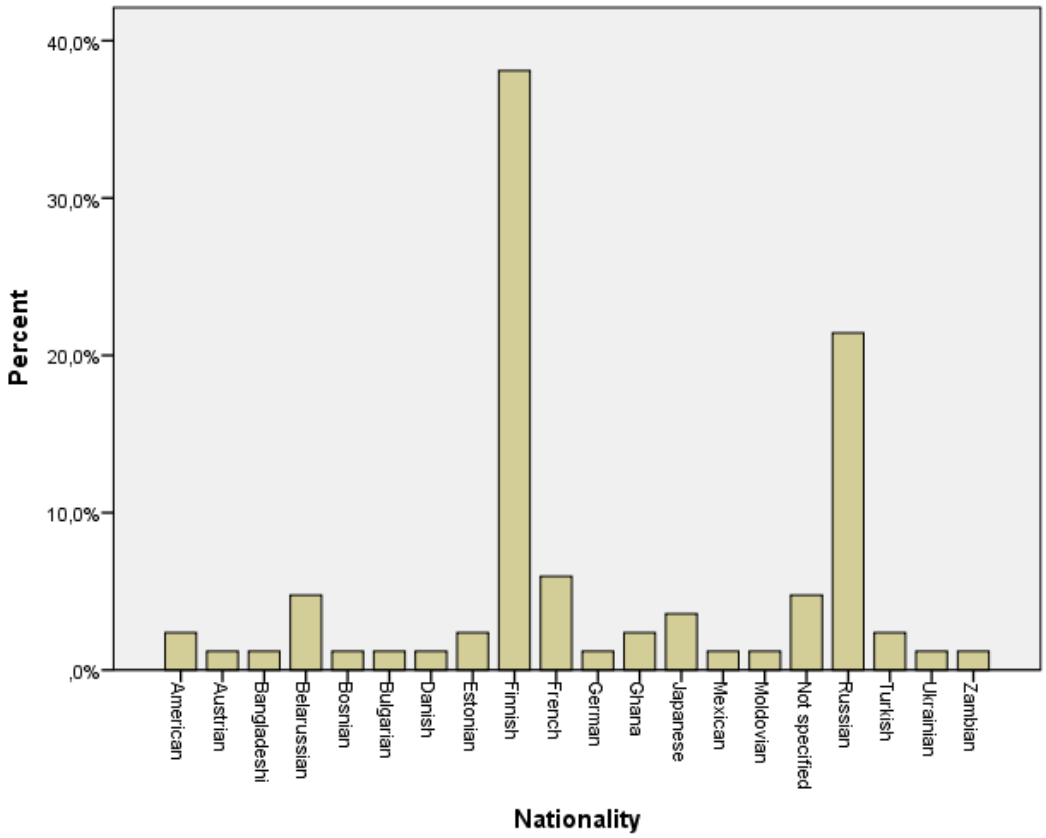

Figure 10. Nationality of the respondents in the sample.

6.1.2. Familiarity with the brands

The respondents were asked to assess their familiarity with the brands. As described earlier they could measure the familiarity on the grade from 0 to 5, where 0 is “not at all familiar” and 5 is “extremely familiar”. The descriptive statistics on the respondents’ familiarity with the brands is shown in Table 11. As depicted in Table 11, the most familiar brands include Google (average grade of 4.48), Nokia (average grade of 4.20), Apple (average grade of 4.13) and Microsoft (average grade of 4.11). The brands, which are least familiar to the respondents, are Oracle (average grade of 2.20), SAP (average grade of 2.33), Cisco (average grade of 2.39), Caterpillar (average grade of 2.56) and General Electric (average grade of 2.70).

Table 11. Respondents' familiarity with the brands.

	N	Minimum	Maximum	Mean	Std. Deviation
Apple	84	1	5	4,13	1,117
Google	84	1	5	4,48	,898
IBM	84	1	5	3,35	1,237
Microsoft	84	1	5	4,11	,957
General Electric	84	1	5	2,70	1,039
Samsung	84	1	5	3,85	1,092
Intel	84	1	5	3,25	1,129
Toyota	84	1	5	3,69	1,097
Mercedes-Benz	84	1	5	3,74	1,043
BMW	84	1	5	3,81	1,058
Cisco	84	1	5	2,39	1,242
Hewlett-Packard	84	1	5	3,32	1,234
Oracle	84	1	5	2,20	1,117
Amazon	84	1	5	3,71	1,188
Honda	84	1	5	3,52	1,237
SAP	84	1	5	2,33	1,302
Ebay	84	1	5	3,62	1,140
Volkswagen	84	1	5	3,81	1,024
Canon	84	1	5	3,89	,982
Philips	84	1	5	3,61	1,087
Ford	84	1	5	3,62	1,097
Hyundai	84	1	5	3,37	1,149
Siemens	84	1	5	3,39	1,232
Sony	84	1	5	3,90	1,060
Audi	84	1	5	3,73	1,112
Nokia	84	1	5	4,20	,967
Caterpillar	84	1	5	2,56	1,320
Dell	84	1	5	3,19	1,294
Xerox	84	1	5	3,02	1,182
Porsche	84	1	5	3,31	1,202
Nintendo	84	1	5	3,54	1,177
Panasonic	84	1	5	3,44	1,186
Harley Davidson	84	1	5	3,20	1,240
Ferrari	84	1	5	3,40	1,262
Johnson-Johnson	84	1	5	3,07	1,306
L'Oreal	84	1	5	3,73	1,186

6.2. Secondary data

Collected and coded secondary data included the figures on companies' advertising investments, R&D investments, R&D intensity, new products developed and brand values. The descriptive statistics for these variables are shown in Appendix 7.

Appendix 8 depicts the brand value path for each of the studied companies through six years of observation. From the graphs in Appendix 8 it can be seen that brand value of studied companies follows different patterns within the observation period. On the other hand independent variables and the character of their changes are depicted in Table 12. The table shows the mean values for advertising expenditures, R&D expenditures, R&D intensity and NPD throughout six moments of observation. The box plots in Appendix 9 show the values of these four variables graphically.

Table 12. Mean values of advertising expenditures, R&D expenditures, R&D intensity and NPD.

	Time periods					
	2008	**2009**	**2010**	**2011**	**2012**	**2013**
Advertising expenditures ($ m)	3250.11	2726.23	2814.56	3130.19	3237.08	3408.39
R&D expenditures ($ m)	3773.97	3606.90	3737.66	4267.33	4557.22	4690.15
R&D intensity (% of sales)	6.34	6.94	6.74	6.84	7.26	7.62
NPD	4434.64	4212.92	3838.17	3666.83	4093.58	4278.61

6.3. Data analysis

The data was analyzed by using linear regression analysis for panel data. For testing the hypotheses related to the relationship between the dependent variable and independent variables *advertising expenditures, R&D expenditures, R&D intensity* and *NPD,* fixed effect model was applied. For the time-invariant independent variable *design* random effect model was utilized.

A panel data analysis is used for analyzing a complex of cross-sectional units, which are observed over time (Hill, Griffiths & Lim, 2008, 383). In the case of the current research there is a group of companies, observed over the period of six years. Panel data can be of different types based on the number of units and observed periods: long and narrow (small number of units and long observation time period), short and wide (many units and short observation period) and long and wide (large number of units and time periods) (Hill, Griffiths & Lim, 2008, 383; Cameron & Trivedi, 2009, 274-276; Park 2011). Since current data includes 36 companies and only six periods of observation, it is short and wide.

The data analysis will be done following a series of several steps (Figure 11). First time-lagged predictor variables will be tested by using a fixed effect model for H1 and H2, where the intercepts are allowed to vary (Pindyck & Rubinfeld, 1998, 252), and a random effect model for H3 and H4. Since different companies might or might not apply all of the discussed long-term brand development strategies or incorporate them to different extent, each hypothesis will be tested separately, thus leading to a set of different models, where the effect of each independent variables will be tested. Following this part of the analysis, random effect model will be run for testing the impact of time-invariant variable *design*.

The decision to use a fixed effect model for H1 and H2 and random effect model for H3 and H4 was based on Hausman test. The test allows to

identify the most suitable model out of two (fixed effect model and random effect model) in the particular situation (Baum, 2006, 230-231). This test helps to evaluate which model corresponds better to the data and the research. The results of the test are depicted in Appendix 10. Hausman test results for *advertising expenses* and *R&D expenses* show, that Prob > chi2 is equal to 0.0001 and 0.0209 respectively. Both values are lower than 0.05, which leads to usage of fixed effect model. For H3 and H4 this value is 0.0939 and 0.4857 respectively, thus leading to application of random effect model.

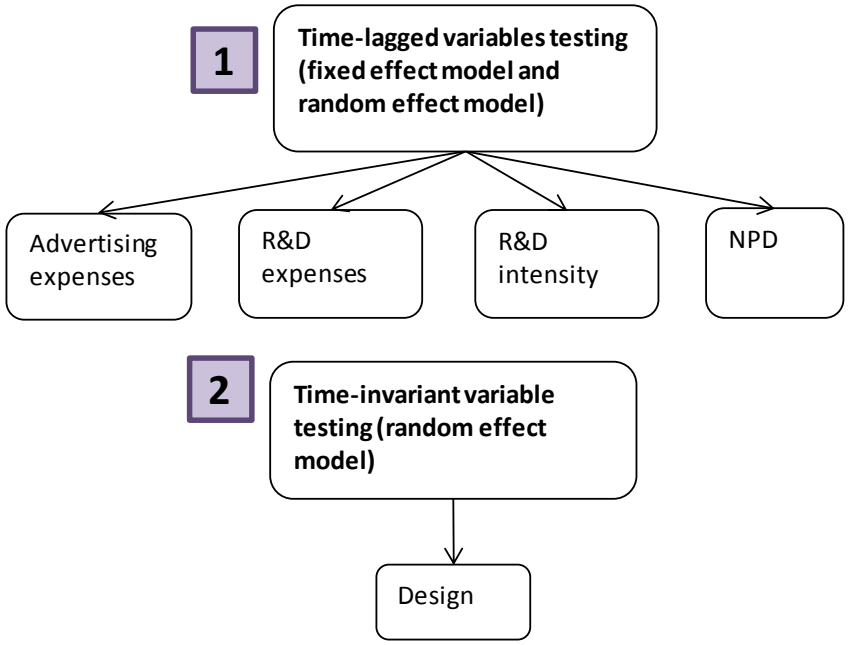

Figure 11. Steps of the analysis.

After completing fixed effect and random effect models, separately a model will be run for examining the relationship between the variable *design* and variables *age*, *gender* and *familiarity with the brands* (Figure 12). This model will allow checking if any of these control variables have an impact on the grades assigned to each of the studied brands.

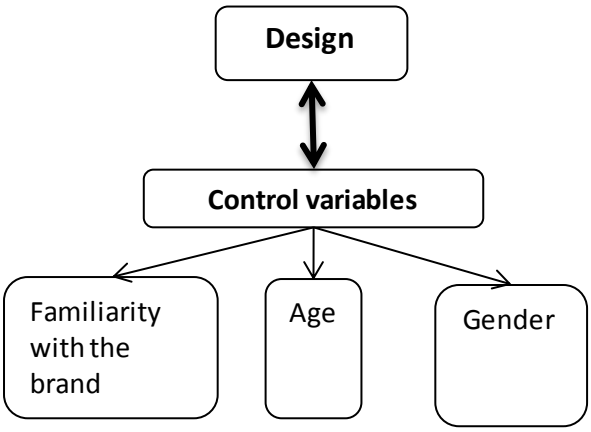

Figure 12. Design and brand value relationship.

Based on the proposed hypotheses and chosen data analysis method, the models can be specified as following. The first step of the model incorporates the proposition that brand value of the companies is linearly related to the lagged values of *advertising expenses, R&D expenses, R&D intensity* and *NPD*. The time lag was chosen to be one year, based on Pearson correlation results between dependent and independent variables. Pearson correlation was performed in order to evaluate what is the best time lag for the present study. For this dependent and independent variables were correlated with different time lags. The results performed with one-year time lag showed the highest values. Since first two variables are incorporated into a fixed effect model and the latter two into a random effect model, mathematically, these two models are the following:

$$BV_{it} = \alpha_i + \beta_1 x_{it-1} + u_{it}. \quad (2)$$

$$BV_{it} = \alpha + \beta_1 x_{it-1} + u_{it} + \varepsilon_{it}. \quad (3)$$

Where

i is a company

t is time

α is unknown intercept of each entity

β is coefficient

x_{it-1} is predictor variables (advertising expenditures, R&D expenditures, R&D intensity and NPD) lagged by one year.

u_{it} is error

ε_{it} is within-entity error.

Next step of the analysis incorporates application of random effect model for time-invariant variable *design.* This model is using general least squares (GLS). The logic behind this model is that entities are supposed to be random. For the present research random effect model mathematically looks as the following:

$$BV_{it} = \alpha + \beta_1 x_{it} + u_{it} + \varepsilon_{it}. \quad (4)$$

Where

i is a company

t is time

α is unknown intercept of each entity

β is coefficient

x_{it} is predictor variable *design*.

u_{it} is between-entity error

ε_{it} is within-entity error.

Separately, a model testing the relationship between the design grades given by the respondents and control variables will be run. This results in the following mathematical model:

$$Design_i = b_0 + b_1 * x_1 + b_2 * x_2 + b_3 * x_3 + e_i. \quad (5)$$

Where

b is intercept

b_j is the value of the j^{th} coefficient, j = 1, 2, 3,

x_j is the value of control variables (age, gender and familiarity with the brands),

e_i is the error in the observed value.

During the primary data collection the respondents were asked to evaluated the brand value of the selected companies. As the last analysis stage the obtained figures will be correlated with the brand values calculated by Interbrand.

Before applying fixed effect model the correlation between the independent variables and dependent variables was checked (including lagged by one year variables). The results are shown in Table 13. It can be already seen from the table that there is a strong correlation between the dependent variable and independent variable *R&D*, as well as there is less significant correlation of the dependent variables with other predictor variables.

Table 13. Correlation between the independent variables and dependent variable.

	RnD	Adv	RnD_int	NPD	Design	BV
RnD	1.0000					
Adv	0.1521 0.0687	1.0000				
RnD_int	0.3571 0.0000	-0.1774 0.0334	1.0000			
NPD	0.3860 0.0000	0.0975 0.2448	-0.0402 0.5597	1.0000		
Design	-0.0288 0.6761	0.1094 0.1917	-0.2061 0.0025	-0.0894 0.1907	1.0000	
BV	0.4406 0.0000	-0.1124 0.1799	0.2039 0.0028	0.1937 0.0043	-0.1639 0.0159	1.0000
	L.RnD	L.Adv	L.RnD~nt	L.NPD	Design	BV
L.RnD	1.0000					
L.Adv	0.1483 0.1046	1.0000				
L.RnD_int	0.3634 0.0000	-0.1795 0.0489	1.0000			
L.NPD	0.4202 0.0000	0.0986 0.2820	-0.0438 0.5597	1.0000		
Design	-0.0371 0.6214	0.0920 0.3153	-0.2051 0.0058	-0.0857 0.2527	1.0000	
BV	0.4167 0.0000	-0.1512 0.0978	0.2038 0.0061	0.1621 0.0297	-0.1639 0.0159	1.0000

6.3.1. Testing time-lagged variables (fixed effect and random effect models)

As indicated in Figure 11 first fixed effect model and random effect model are used for time-lagged predictor variables. The values of the independent variables are lagged by one year. The decision to use one-year time lag was based on Pearson correlation between the variables lagged by different time periods. Four independent variables form four separate models, where *brand value* is dependent variable. The results of the model application can be seen from the Figure 13.

Lagged *advertising expenses* and *brand value*

```
Fixed-effects (within) regression               Number of obs      =       121
Group variable: ID                              Number of groups   =        25

R-sq:  within  = 0.1606                         Obs per group: min =         2
       between = 0.0422                                        avg =       4.8
       overall = 0.0229                                        max =         5

                                                F(1,95)            =     18.18
corr(u_i, Xb)  = -0.6844                        Prob > F           =    0.0000
```

BV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Adv L1.	4.421959	1.03702	4.26	0.000	2.363214	6.480704
_cons	9045.755	3244.626	2.79	0.006	2604.358	15487.15
sigma_u	26113.955					
sigma_e	8944.2213					
rho	.89500574	(fraction of variance due to u_i)				

F test that all u_i=0: F(24, 95) = 22.50 Prob > F = 0.0000

Lagged *R&D expenses* and *brand value*

```
Fixed-effects (within) regression               Number of obs      =       180
Group variable: ID                              Number of groups   =        36

R-sq:  within  = 0.3122                         Obs per group: min =         5
       between = 0.1628                                        avg =       5.0
       overall = 0.1737                                        max =         5

                                                F(1,143)           =     64.91
corr(u_i, Xb)  = -0.4022                        Prob > F           =    0.0000
```

BV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
RnD L1.	5.29569	.6572835	8.06	0.000	3.996443	6.594938
_cons	-1595.506	2668.467	-0.60	0.551	-6870.244	3679.232
sigma_u	17675.722					
sigma_e	6684.6902					
rho	.87487244	(fraction of variance due to u_i)				

F test that all u_i=0: F(35, 143) = 29.30 Prob > F = 0.0000

Lagged *R&D intensity* and *brand value*

```
Random-effects GLS regression                   Number of obs      =       180
Group variable: ID                              Number of groups   =        36

R-sq:  within  = 0.0052                         Obs per group: min =         5
       between = 0.0564                                        avg =       5.0
       overall = 0.0415                                        max =         5

                                                Wald chi2(1)       =      0.02
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.8766
```

BV	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
RnD_int L1.	67.49413	434.5386	0.16	0.877	-784.1859	919.1742
_cons	19065.29	4146.493	4.60	0.000	10938.31	27192.27
sigma_u	16919.687					
sigma_e	8039.4055					
rho	.81581477	(fraction of variance due to u_i)				

Lagged *NPD* and *brand value*

```
Random-effects GLS regression                   Number of obs      =       180
Group variable: ID                              Number of groups   =        36

R-sq:  within  = 0.0004                         Obs per group: min =         5
       between = 0.0322                                        avg =       5.0
       overall = 0.0263                                        max =         5

                                                Wald chi2(1)       =      0.70
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.4030
```

BV	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
NPD L1.	.2697592	.3225627	0.84	0.403	-.3624521	.9019706
_cons	18433.74	3194.668	5.77	0.000	12172.31	24695.18
sigma_u	17143.233					
sigma_e	8058.8487					
rho	.81901164	(fraction of variance due to u_i)				

L1 – one year lagged.

Figure 13. Fixed effect model.

The number of observation constituted 180 for all variables except *advertising expenses.* Similarly, number of groups is 36 (number of participating companies) for *R&D expenses, R&D intensity* and *NPD,* while this number is 25 for *advertising expenses* due to missing values. As shown in Figure 13 the results of incorporating different independent variables are different. While the results of the models including *adverting expenses* and *R&D expenses* are statistically significant ($p < 0.05$), the other two models show non-significant results. Change in our unit of one year lagged advertising expenditures contributes 4.421959 units to brand value. This means, that H1 is supported, stating that advertising investments of high-technology companies lead to higher brand value in the long run. Similarly, change in our unit of one year lagged R&D expenditures contributes 5.29569 units to brand value. And as well as for the previous hypothesis H2 is proved as well, concluding that R&D expenditures of high-technology companies bring positive long-term effect on the brand value of these companies. On the other hand, the results shown by two other models (with *R&D intensity* and *NPD*) are non-significant. Thus, running the models with these independent variables did not support stated propositions, saying that R&D intensity and NPD lead to positive brand value change in the long-term for high-technology companies.

Furthermore, interclass correlation *rho* was shown to be 0.89500574 and 0.87487244 for *advertising expenses* and *R&D expenses* respectively. This number shows which percent of variance is due to differences across panels (Torres-Reyna, 2014). Thus, for instance, in the first model about 90% of variance is explained by differences across panels.

6.3.2. Testing time-invariant variable (random effect model)

The next step of the analysis is application of random effect model for time-invariant variable *design* and its effect on the dependent variable. A random effect model was chosen, since the independent variable is not

changing over time, but stays constant. The results of the analysis are depicted in Figure 14.

```
Random-effects GLS regression                   Number of obs      =       216
Group variable: ID                              Number of groups   =        36

R-sq:  within  = 0.0000                         Obs per group: min =         6
       between = 0.0322                                        avg =       6.0
       overall = 0.0269                                        max =         6

Random effects u_i ~ Gaussian                   Wald chi2(1)       =      1.13
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.2878
```

BV	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Design	-9697.682	9124.137	-1.06	0.288	-27580.66	8185.298
_cons	54441.46	33365.4	1.63	0.103	-10953.51	119836.4
sigma_u	16498.86					
sigma_e	8083.9767					
rho	.80640453	(fraction of variance due to u_i)				

Figure 14. Random effect model.

The figure above shows that the effect of design on brand value of high-technology companies is negative and not statistically significant (at the 5% significance level). Thus, H5 is not supported and the assumption that design leads to higher brand value is not proved.

6.3.3. Diagnostics of the model

The applied model has been checked and Appendix 11 gives the information on the distribution of the residuals, when the independent variables are incorporated separately into the model and *brand value* is dependent variable. The figures for the first two models (ones which are supported) are fairly normally distributed, but have heavier tales than a usual normal distribution. It proves the assumption of normality, except some outliers. The figures for the other three models show that the distribution is bimodal.

6.3.4. Incorporating control variables

For testing if control variables have any effect on the evaluation of the companies' design given by the respondents, a regression has been run. Design grade has been assigned the role of a dependent variable, while *gender, age* and *familiarity with the brands* are independent variables. The results of the model are shown in Table 14 and Table 15.

Table 14. Model summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,473	,224	,149	.79690

Table 15. Coefficients of the model.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,485	,895		2,775	,007
	Age_1	,085	,834	,044	,101	,920
	Age_2	-,021	,816	-,012	-,025	,980
	Age_3	,312	,863	,095	,361	,719
	Age_4	-,138	,854	-,045	-,161	,872
	Age_5	-1,000	,931	-,220	-1,075	,286
	Gender_dummy	-,204	,199	-,116	-1,027	,308
	Brands_familiarity	,344	,110	,335	3,138	,002

Here the age groups are distributed as following: Age_1 – 18-24 years old, Age_2 – 25-29 years old, Age_3 – 30-34 years old, Age_4 – 35-44 years old, Age_5 – 45-54 years old, Age_6 – 65+.

Based on the results of the analysis, the regression coefficient constituted 0.224, which shows a positive but not strong relation between the grades given by the respondents and control variables. Moreover, the variables *gender* and *age* do not contribute to the model. On the other hand

familiarity with the brand has a positive effect on design evaluation of the brand, meaning that the more a person is familiar with the brand – the higher he/ she evaluates the design of this brand's products.

6.3.5. Comparing brand value from secondary and primary data

During primary data collection the respondents were also asked to evaluate the brand value of the selected high-technology companies (descriptive statistics for the values are depicted in Appendix 7). The obtained grades were correlated with the brand value calculated by Interbrand consultancy. The results of the correlation are presented in Table 16.

Table 16. Correlation between brand value from primary and secondary data.

		BV_pd	BV_sd_mean
BV_pd	Pearson Correlation	1	,121
	Sig. (2-tailed)		,077
	N	216	216
BV_sd_mean	Pearson Correlation	,121	1
	Sig. (2-tailed)	,077	
	N	216	216

Based on the results from the table there is no significant correlation between the brand value assigned to the companies by the respondents and brand value calculated by Interbrand. Such result might be due to the sample characteristics and sample size. Moreover, Interbrand uses besides consumer (demand) analysis, financial and competitive analysis parts (Rocha, 2014a), which leads to a different brand value calculation approach.

6.3.6. Summary of hypotheses testing

Conducted analysis tested the research hypotheses. First, based on the theory overview it has been proposed that advertising expenditures have positive effect on brand value in the long-run (H1). Advertising expenditures were lagged by one year as well as other independent variables coming from secondary data. This hypothesis was approved during the analysis, as change in one unit in advertising investments lead to positive change of 4.421959 in brand value of the companies. The second hypothesis proposed that R&D expenditures lead to higher brand value in the long term (H2). This hypothesis was supported as well, showing that change in one unit in R&D investments is followed by change of 5.29569 units in brand value, thus being of positive effect. The third hypothesis declares that R&D intensity has positive impact on brand value (H3). This hypothesis was rejected, as the results of the analysis were statistically non-significant. Similarly to H3, two last hypotheses (H4 and H5) were not supported as well, since the results of the analysis did not show statistical significance and the positive effect of the last three strategies on brand value was not found.

Testing of control variables showed that the respondents are influenced in their evaluation of design by the extent of their familiarity with the brands, while age and gender did not appear to contribute to the variance in the responses. Furthermore, brand value assigned to the brand by the respondents did not correlate with the brand value obtained from the secondary data, as the results of the correlation were non-significant. Tested hypotheses are summarized further in Table 17. Next chapter includes discussion of the conducted analysis and findings.

Table 17. Summary of tested hypotheses.

H1	Advertising has a positive effect on brand value of high-technology companies in the long run.	Supported
H2	R&D expenditures have a positive effect on brand value of high-technology companies in the long run.	Supported
H3	R&D intensity has a positive effect on brand value of high-technology companies in the long run.	Not supported
H4	New product development has a positive effect on brand value of high-technology companies in the long run.	Not supported
H5	Design has a positive effect on brand value of high-technology companies.	Not supported

7. DISCUSSION AND CONCLUSIONS OF THE RESEARCH

The aim of the current research was to investigate the long term effect of brand development strategies for high-technology companies. Five strategies were in the focus of the study: investments in advertising, investments in R&D, R&D intensity, NPD and design. The effect of the latter could not be checked in the long-run because of the data availability. Though, its impact on brand value was tested. For the research purposes data was collected from primary (survey) and secondary (annual reports, Interbrand's ranking) resources. Primary data collection, conducted in May 2014, allowed also testing which factors influence consumers' evaluation of the design.

Two out of five hypotheses were supported. Thus, advertising and R&D expenditures appeared to bring lagged effect on brand value of high-technology companies. Lagged by one year advertising and R&D investments showed positive impact on brand value, meaning that for the companies, which invested in these two strategies in the current year, the brand value next year will be positively changed.

Three other hypotheses were not supported, as the results were not statistically significant. Thus, the results did not show positive effect of R&D intensity (lagged by one year), NPD (lagged by one year) and design on brand value of high-technology companies. One of the reasons that two first hypotheses were supported and last three not might be the difference in the essence of each of these strategies. Thus, first two hypotheses suggested the effect of companies' investments, while rejected hypotheses represent ratio (R&D intensity), number of patents (NPD) and grades given by the respondents (design). And while made investments can be seen in companies' future performance and results, R&D intensity for instance might act simply as a measure of made investments. On the other hand, NPD were measured as a number of patents registered by a specific company in a particular time period. While some products or

components are patented in one year, they might be created earlier. Moreover, the numbers of registered patents were taken from one of numerous existing patent databases (Espacenet) and the data differs from one database to another. Furthermore, NPD might bring more for the companies in terms of financial value and financial performance (Pauwels et al. 2004). Similarly to two previous hypotheses, H5 was rejected, since the results were statistically non-significant. The importance of design for brand value generation cannot be declined (Walsh, Roy & Bruce, 1998; Hall, 1993; Borja de Mozota, 2003). However, because in the current research design acted as a time-invariant strategy, it appeared to be impossible to measure its long-term effect on brand value, while general effect of design on brand value was not proved. Moreover, primary data collection (sample, sample's size and collected responses) put some constraints on analysis conduct.

Additional testing showed which factors might influence consumers' relation to design of particular companies' products. While three of such factors were tested (age, gender and familiarity with the brands), only familiarity with the brands showed positive effect on design evaluation. On the contrary, age and gender did not appear to contribute much to the model. This means that the consumers tend to evaluate those brands higher, with which they are familiar the most. This supports previous research conducted on this topic (Dacin & Smith, 1994; Sujan 1985; Hong & Sternthal, 2010).

During primary data collection, the respondents' evaluation of brands was requested. This resulted in obtained brand value for the selected company, which was further compared to the brand value generated by Interbrand. The conducted test did not show any relationship between these two values. The reason for this might be different value calculation. While respondents evaluated the brand based on their emotional connection, knowledge and information available, Interbrand utilizes a

complex method, which includes demand, financial and competitive analyses.

7.1. Theoretical implications

The current study contributes to the theory of brand value generation and opens future research paths. The study includes a range of strategies influencing brand value and supports earlier findings made by Mela, Ataman and Heerde (2006) and Chu and Keh (2006), stating that advertising brings positive change on brand value in the long run. The latter research aimed at finding the level of R&D investment, at which brand value is increased. Thus, this study contributes to the research conducted by Chu and Keh (2006) and proves that investing in R&D leads to increased long-term brand value. It is important to notice that no previous research was concentrated on studying brand value generation within high-technology companies. Thus, the current study provides valuable insights inherent specifically to high-technology industry. This might be of strong importance, since the means of achieving high brand value and stable performance differ from industry to industry. That is the reason why three out of five studied in the present research components, namely R&D investments, R&D intensity and NPD, relate to high-technology industry. While these strategies seem important to high-technology companies, advertising and design are also of high relevance. Supported hypothesis of positive effect of advertising on brand value generation, proves that no matter what kind of industry a company operates in, advertising is an essential strategy for branding. Customers tend to prefer known products and services and are eager to pay price premiums for them (Mela, Gupta & Lehmann, 1997). In the context of the present study and based on the primary data collection advertising has been shown to be the key in the brand valuation of the respondents: the better they know the brand – the higher the value associated with the brand. Thus, from the primary data collection the most known to the respondents brands, such as Google (average grade of 4.48), Apple

(4.13) and Microsoft (4.11) were valued highly by the respondents as well: average grade of more than 4 out of 5 points.

Moreover, the current research investigated the effect of other long-term brand development strategies, including research and development and design. Even though the hypotized propositions were not supported, the research gives the grounds for studying these phenomena further on and conduct analysis with different sample and more time observation periods. While the hypotheses related to the long-term effect of R&D intensity and NPD on brand value were not supported in the current context, they can show positive impact on brand value within the frames of another research with a different sample and panel data, including more time periods. One of the reasons for H3 and H4 to be rejected in this work is a relatively short panel data, incorporating only six time periods. Changes made in one or several of the discussed strategies might not show their full effect within such time frames. Thus, for the future research with longer panel data the same strategies can show positive effect on brand value in the long-run. The current research was the first effort to incorporate all long-term brand development strategies, where design was considered as one as well.

To sum up, the present study enabled to widen the knowledge about brand value generation, especially in relation to a specific industry (high-technology). The strategies for brand value generation were identified; however more research is needed in this direction.

7.2. Managerial implications

Having high brand value and a strong brand allows the companies to created better customer loyalty, charge price premiums and improve their performance (Mela, Gupta & Lehmann, 1997). Therefore, it is necessary to understand how brand value is created and what the means of its leverage are. Knowing this will allow the companies to concentrate on right strategies and in right combination. Companies today are not concerned

only with fast revenues. On the contrary for healthy functioning of the company and its operations more should be done to ensure long-term efficiency. Having a strong and highly valued brand in the long run is one of the necessities. In line with this the current research incorporates a set of long-term brand development strategies and indicates there importance. Empirically proved long-term strategies, namely advertising investments and R&D investments, have been shown to be of high importance. Thus, investing in advertising and R&D in a current year will bring positive change on brand value in next year.

Additional test run on design evaluation showed that the respondents tend to value those brands higher, with which they are familiar. Thus, this creates a necessity for the companies to make sure that their brands are known by the customers. A great example of making brand known by its customer is Google, which was one of the researched companies in the present study. Secondary data showed that advertising expenditures of Google are immense in relation to the company's sales. Thus, advertising expenditures grew constantly from 2008 to 2013, reaching more than 12% out of revenues in 2013. Primary data in its turn showed that these expenditures brought the results: Google is one of the companies that the respondents are the most familiar with.

Moreover, high-technology companies differ in their functioning and a different approach is needed here. Differences also exist in brand value creation for high-technology companies. This study focuses on this specific industry and covers the strategies, which are relevant for the companies operating in this area. Thus companies, working in high-technology sectors, can apply a set of strategies fitting to them to ensure having a brand with high value in the future.

7.3. Reliability and validity of the research

According to McBurney and White (2007, 173) validity is *"an indication of accuracy in terms of the extent to which a research conclusion corresponds with reality"*. Internal validity can be treated as good for the current research, since used measures were already applied by previous studies. On the contrary, external validity is hard to evaluate, since the current research covered only 36 high-technology companies and used the data for only six consequent years. Thus, generalizing the results of the study might be not fully appropriate for other high-technology companies (Parasuraman, Grewal & Krishnan, 2007, 223). However, as the secondary data the figures from the companies' annual reports have been taken, which gives the base to assume high validity of the obtained data. Moreover, the core of the research - brand values – were obtained from the ranking, composed by Interbrand consultancy, using its unique approach for brand value calculation. Interbrand's method is considered to be reliable (Seetharaman, Zainal & Gunalan, 2001; Smith, Gradojevic & Irwin, 2007; Soto, 2008). Thus, Madden, Fehle and Fournier (2006) suggest Interbrand being a leader for calculation brand values. Thus, the validity and reliability of the numbers provided by Interbrand are considered high.

On the other hand, reliability is the degree to which chosen tools provide coherent results (Parasuraman, Grewal & Krishnan, 2007, 270). Evaluating reliability of chosen measurements does not seem possible, since the strategies (advertising expenses, R&D expenses, R&D intensity, NPD and design) were represented by single items. On the other hand, single items measures are successfully used by the researchers to study global concepts (Moss, 2008), brand value being one of them. Moreover, Berkqvist and Rossiter (2007) showed that concrete constructs should be measured with single-item measurers.

7.4. Limitations and further research directions

There are several limitations in this research, which should be taken into account. Firstly, the data collected for testing the effect of design on brand value included a limited number of responses. Moreover, since the survey was initially placed on student social network webpages and was conducted in a snowball form, there are some limitations on the sample usage and the patterns were seen in respondents' age and nationality. Thus, generalizing the results to other consumers seems inappropriate. Furthermore, according to the survey, some brands were not very familiar to the respondents, thus leading to lower evaluation grades assigned to these brands. It would be interesting to run a similar kind of test with a different and bigger sample.

One more issue concerning testing the impact of design relates to impossibility to test its long-term effect on brand value in the frames of the current research. Though, there are premises to consider the existence of positive effect of design on companies' brand value, it would be useful to test them empirically.

There is also a limitation related to a sample of selected companies, which are in the focus of the present study. The sample used in the research included only high-technology companies with greatly strong brands. These companies were in the Top 100 for the consequent six years, meaning that their brands reflect strength and successful performance. High-technology companies were selected by utilizing a high-technology index created during the conduct of the study, thus including only 36 companies. Moreover as stated earlier, the data for these companies was obtained only for six years. Therefore, the results of the analysis should be interpreted with some caution and in relation to the sample. While the sample represents high-technology companies with the highest brand values, it seems inappropriate to generalize results on other companies. Moreover, the companies utilized in the current research have different

reporting styles, including differences in currency used in the reports, formats of the reporting and the time of reports' publishing. This imposed some difficulties in calculating the measures from the secondary data.

It was stated at the beginning of the study, that short-term brand development strategies, with sales promotion mostly used, would be omitted in the current study. However, these strategies are important for bringing quick outcomes of their implementation (Mela, Gupta & Lehmann, 1997; Mela, Ataman & Heerde, 2006). Many companies adopt short-term strategies due to several reasons: their effect is seen immediately and it is easy to be measured. Managers tend to implement such strategies since the results of those will benefit themselves and not their followers. (Bijmolt, Heerde & Pieters, 2005) The effect of sales promotions on firm value and revenues has been studied by several researchers (Pauwels et al., 2004; Mela, Ataman and Heerde (2006), showing that sales promotions depreciate a brand. For the future research, it would be interesting to study the effect of short-term brand development strategies within high-technology industry and compare it with the effect of long-term strategies.

There has been not much research conducted in relation to brand value generation and high-technology sectors. Though, marketing of high-technology products and services is a well-studied area, there have not been sufficient amount of research concentrating on building long-term brand value for the companies, providing such products and services.

To finalize this research was intended at testing possible long-term brand development strategies. And even though, not all propositions were proved, the study opens possibility to run further research on this topic by utilizing different and bigger samples and different analysis methods. This would bring more insights on how companies can control and leverage their brand value.

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APPENDICES

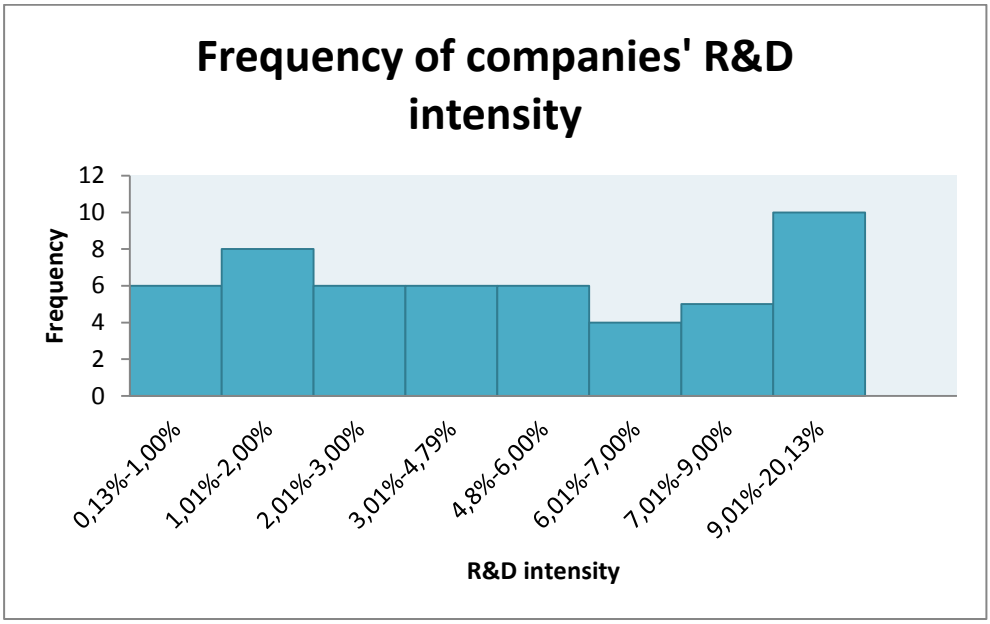
Appendix 1. Top 50 countries by R&D investments in 2013. (European Commission, 2013)

World rank	Name	Country	Industrial sector
1	VOLKSWAGEN	Germany	Automobiles & Parts
2	SAMSUNG ELECTRONICS	South Korea	Electronic & Electrical Equipment
3	MICROSOFT	USA	Software & Computer Services
4	INTEL	USA	Technology Hardware & Equipment
5	TOYOTA MOTOR	Japan	Automobiles & Parts
6	ROCHE	Switzerland	Pharmaceuticals & Biotechnology
7	NOVARTIS	Switzerland	Pharmaceuticals & Biotechnology
8	MERCK US	USA	Pharmaceuticals & Biotechnology
9	JOHNSON & JOHNSON	USA	Pharmaceuticals & Biotechnology
10	PFIZER	USA	Pharmaceuticals & Biotechnology
11	DAIMLER	Germany	Automobiles & Parts
12	GENERAL MOTORS	USA	Automobiles & Parts
13	GOOGLE	USA	Software & Computer Services
14	ROBERT BOSCH	Germany	Automobiles & Parts
15	SANOFI-AVENTIS	France	Pharmaceuticals & Biotechnology
16	HONDA MOTOR	Japan	Automobiles & Parts
17	SIEMENS	Germany	Electronic & Electrical Equipment
18	CISCO SYSTEMS	USA	Technology Hardware & Equipment
19	PANASONIC	Japan	Leisure Goods
20	GLAXOSMITHKLINE	UK	Pharmaceuticals & Biotechnology
21	IBM	USA	Software & Computer Services
22	NOKIA	Finland	Technology Hardware & Equipment
23	FORD MOTOR	USA	Automobiles & Parts
24	SONY	Japan	Leisure Goods
25	NISSAN MOTOR	Japan	Automobiles & Parts
26	ELI LILLY	USA	Pharmaceuticals & Biotechnology

27	BMW	Germany	Automobiles & Parts
28	ERICSSON	Sweden	Technology Hardware & Equipment
29	ORACLE	USA	Software & Computer Services
30	EADS	The Netherlands	Aerospace & Defence
31	HUAWEI	China	Technology Hardware & Equipment
32	GENERAL ELECTRIC	USA	General Industrials
33	ASTRAZENECA	UK	Pharmaceuticals & Biotechnology
34	FIAT	Italy	Automobiles & Parts
35	ABBOTT LABORATORIES	USA	Pharmaceuticals & Biotechnology
36	BAYER	Germany	Pharmaceuticals & Biotechnology
37	HITACHI	Japan	Electronic & Electrical Equipment
38	QUALCOMM	USA	Technology Hardware & Equipment
39	DENSO	Japan	Automobiles & Parts
40	BRISTOL-MYERS SQUIBB	USA	Pharmaceuticals & Biotechnology
41	TAKEDA PHARMACEUTICAL	Japan	Pharmaceuticals & Biotechnology
42	BOEHRINGER INGELHEIM	Germany	Pharmaceuticals & Biotechnology
43	TOSHIBA	Japan	General Industrials
44	CANON	Japan	Technology Hardware & Equipment
45	HEWLETT-PACKARD	USA	Technology Hardware & Equipment
46	APPLE	USA	Technology Hardware & Equipment
47	AMGEN	USA	Pharmaceuticals & Biotechnology
48	PEUGEOT (PSA)	France	Automobiles & Parts
49	ALCATEL-LUCENT	France	Technology Hardware & Equipment
50	NTT	Japan	Fixed Line Telecommunications

Appendix 2. R&D intensity of the selected 80 companies from Interbrand

№	Companies	R&D intensity	№	Companies	R&D intensity
1	Smirnoff	0,13%	41	Nintendo	8,42%
2	Pizza Hut	0,28%	42	Pepsico	9,79%
3	KFC	0,28%	43	Ebay	11,02%
4	Shell	0,29%	44	Johnson-Johnson	11,50%
5	Avon	0,68%	45	Cisco	12,22%
6	Adidas	0,88%	46	Oracle	13,00%
7	Danone	1,29%	47	Microsoft	13,37%
8	Kellogg's	1,35%	48	Google	13,37%
9	Colgate	1,53%	49	SAP	14,00%
10	Nescafe	1,63%	50	Nokia	17,84%
11	Nestle	1,63%	51	Intel	20,13%
12	Kleenex	1,70%	52	Cola	N/A
13	Dell	1,90%	53	McDonald's	N/A
14	Hyundai	1,93%	54	Disney	N/A
15	Gilette	2,40%	55	American Express	N/A
16	Accenture	2,50%	56	Louis Vuitton	N/A
17	Harley-Davidson	2,58%	57	Citi	N/A
18	Apple	2,62%	58	H&M	N/A
19	HP	2,80%	59	HSBC	N/A
20	Xerox	2,80%	60	Nike	N/A
21	GE	3,25%	61	UPS	N/A
22	Toyota	3,66%	62	Budweiser	N/A
23	Caterpillar	3,68%	63	Ikea	N/A
24	L'Oreal	3,70%	64	J.P. Morgan	N/A
25	Ford	4,36%	65	Goldman Sachs	N/A
26	BMW	4,79%	66	Morgan Stanley	N/A
27	Samsung	5,25%	67	Thomson Reuters	N/A
28	Siemens	5,66%	68	Gucci	N/A
29	Honda	5,67%	69	MTV	N/A
30	Mercedez-Benz	5,80%	70	AXA	N/A
31	VW	5,96%	71	Heinz	N/A
32	Porsche	5,96%	72	Zara	N/A
33	IBM	6,03%	73	Hermes	N/A
34	Ferrari	6,34%	74	GAP	N/A
35	Panasonic	6,88%	75	Cartier	N/A
36	Sony	6,96%	76	Tiffany and Co.	N/A
37	Philips	7,43%	77	Allianz	N/A
38	Amazon	7,47%	78	Moet & Chandon	N/A
39	Audi	7,95%	79	Starbucks	N/A
40	Canon	8,21%	80	Visa	N/A



Descritptive statistics	
Mean	0,057033
Standard Error	0,00664
Median	0,0479
Mode	0,0028
Standard Deviation	0,047422
Sample Variance	0,002249
Minimum	0,0013
Maximum	0,2013

Appendix 3. Interbrand's work by industry (Interbrand, 2013d)

1	Automotive
2	Consumer products
3	Energy, utilities
4	Financial services
5	Food & beverages
6	Government
7	Healthcare & sciences
8	Hospitality, travel & leisure
9	Luxury
10	Media & publishing
11	Non-profit & organizations
12	Professional services
13	Retail
14	Sports & entertainment
15	Technology
16	Telecommunication

Appendix 4. Brand value comparison for 2013 (Interbrand, 2013; BrandZ, 2013)

Company	Brand value ($ m)	
	Interbrand	BrandZ
Apple	98316	185071
Google	93291	116669
IBM	78808	112536
Microsoft	59546	69814
GE	46947	55357
Samsung	39610	21404
Intel	37257	13757
Toyota	35346	24497
Mercedez-Benz	31904	17952
BMW	31839	24015
Cisco	29053	11816
HP	25843	16362
Oracle	24088	20039
Amazon	23620	45727
Honda	18490	12401
SAP	16676	34365
Ebay	13162	17749
VW	11120	8790
Canon	10989	not in the top 100
Philips	9813	not in the top 100
Ford	9181	not in the top 100
Hyundai	9004	not in the top 100
Siemens	8503	12331
Sony	8408	not in the top 100
Audi	7767	not in the top 100
Nokia	7444	not in the top 100
Caterpillar	7125	not in the top 100
Dell	6845	not in the top 100
Xerox	6779	not in the top 100
Porsche	6471	not in the top 100
Nintendo	6086	not in the top 100
Panasonic	5821	not in the top 100
Johnson & Johnson	4777	not in the top 100
L'Oreal	9874	17971
Harley-Davidson	4230	not in the top 100
Ferrari	4013	not in the top 100

Appendix 5. The questionnaire

Q1 What is your gender?

- ❍ Male
- ❍ Female

Q2 What is your age?

- ❍ 18-24
- ❍ 25-29
- ❍ 30-34
- ❍ 35-44
- ❍ 45-54
- ❍ 55-64
- ❍ 65+

Q3 What is your nationality?

Q4 How familiar are you with the following brands?

	Not at all familiar	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
Apple	❍	❍	❍	❍	❍
Google	❍	❍	❍	❍	❍
IBM	❍	❍	❍	❍	❍
Microsoft	❍	❍	❍	❍	❍
General Electric	❍	❍	❍	❍	❍
Samsung	❍	❍	❍	❍	❍
Intel	❍	❍	❍	❍	❍
Toyota	❍	❍	❍	❍	❍
Mercedes-Benz	❍	❍	❍	❍	❍
BMW	❍	❍	❍	❍	❍
Cisco	❍	❍	❍	❍	❍
Hewlett-Packard	❍	❍	❍	❍	❍
Oracle	❍	❍	❍	❍	❍
Amazon	❍	❍	❍	❍	❍
Honda	❍	❍	❍	❍	❍
SAP	❍	❍	❍	❍	❍
Ebay	❍	❍	❍	❍	❍
Volkswagen	❍	❍	❍	❍	❍
Canon	❍	❍	❍	❍	❍
Philips	❍	❍	❍	❍	❍
Ford	❍	❍	❍	❍	❍
Hyundai	❍	❍	❍	❍	❍
Siemens	❍	❍	❍	❍	❍
Sony	❍	❍	❍	❍	❍
Audi	❍	❍	❍	❍	❍
Nokia	❍	❍	❍	❍	❍
Caterpillar	❍	❍	❍	❍	❍
Dell	❍	❍	❍	❍	❍
Xerox	❍	❍	❍	❍	❍
Porsche	❍	❍	❍	❍	❍
Nintendo	❍	❍	❍	❍	❍
Panasonic	❍	❍	❍	❍	❍
Harley Davidson	❍	❍	❍	❍	❍
Ferrari	❍	❍	❍	❍	❍
Johnson-Johnson	❍	❍	❍	❍	❍
L'Oreal	❍	❍	❍	❍	❍

Q5 Please grade DESIGN of each brand on scale from 0 to 5 on given characteristics.

Q6 Apple

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q7 Google

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q8 IBM

	0	1	2	3	4	5	I am not familiar

							with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q9 Microsoft

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q10 General Electric

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍

Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q11 Samsung

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q12 Intel

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍

Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q13 Toyota

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q14 Mercedes-Benz

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍

Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q15 BMW

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q16 Cisco

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this	❍	❍	❍	❍	❍	❍	❍

company Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q17 Hewlett-Packard

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q18 Oracle

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q19 Amazon

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q20 Honda

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q21 SAP

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q22 Ebay

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q23 Volkswagen

	0	1	2	3	4	5	I am not familiar with the brand

Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q24 Canon

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q25 Philips

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍

Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q26 Ford

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q27 Hyundai

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall	❍	❍	❍	❍	❍	❍	❍

product satisfaction							
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q28 Siemens

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q29 Sony

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance	❍	❍	❍	❍	❍	❍	❍

of design for this company							
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q30 Audi

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q31 Nokia

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall	❍	❍	❍	❍	❍	❍	❍

brand value							

Q32 Caterpillar

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q33 Dell

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q34 Xerox

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q35 Porsche

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q36 Nintendo

	0	1	2	3	4	5	I am not familiar

							with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q37 Panasonic

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q38 Harley Davidson

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍

Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q39 Ferrari

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q40 Johnson-Johnson

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍

Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q41 L'Oreal

	0	1	2	3	4	5	I am not familiar with the brand
Aesthetics	❍	❍	❍	❍	❍	❍	❍
Ease of use	❍	❍	❍	❍	❍	❍	❍
Reliability	❍	❍	❍	❍	❍	❍	❍
Safety	❍	❍	❍	❍	❍	❍	❍
Overall product satisfaction	❍	❍	❍	❍	❍	❍	❍
Overall importance of design for this company	❍	❍	❍	❍	❍	❍	❍
Overall brand value	❍	❍	❍	❍	❍	❍	❍

Q42 If you wish to participate in the lottery, please provide us with your contact information. Your contact information will not be used for any other purposes.

Name
Telephone
Email address

Appendix 6. Exchange rates (to 1 USD)

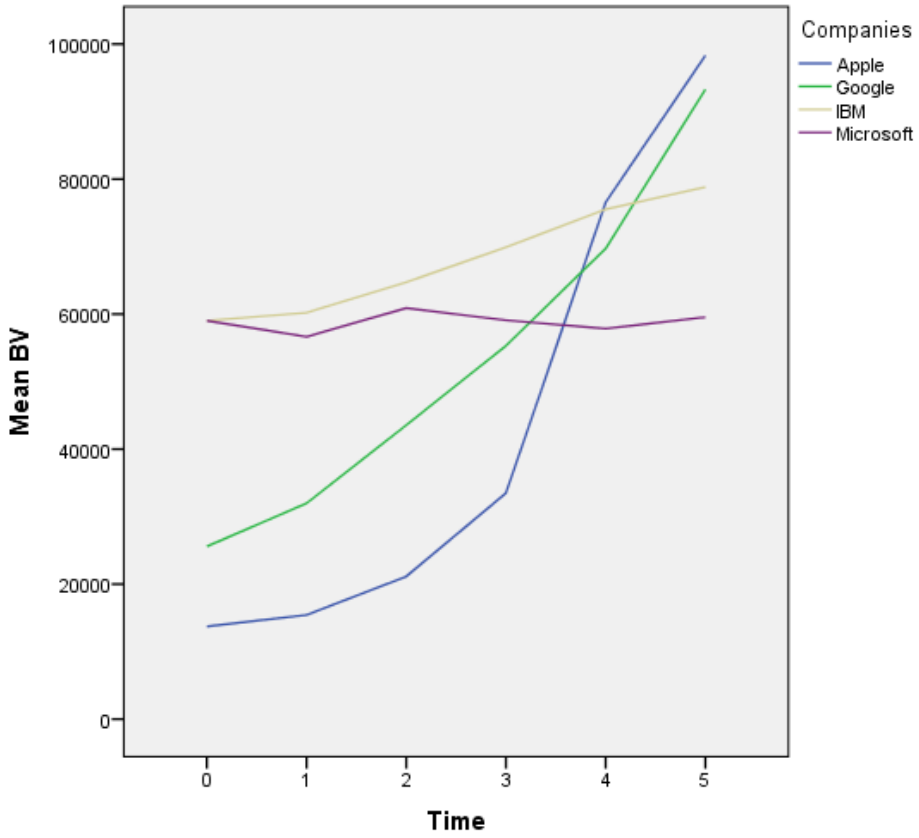
Company	Year					
	2008	2009	2010	2011	2012	2013
Samsung	₩1257.00	₩1153.30	₩1153.30	₩1153.30	₩1171.10	-
Toyota	¥100.19	¥98.23	¥93.04	¥83.15	¥82.19	¥94.05
Mercendes-Benz	€0.680	€0.694	€0.748	€0.773	€0.758	€0.752
BMW	€0.680	€0.694	€0.748	€0.773	€0.758	€0.752
Honda	¥114.00	¥101.00	¥93.00	¥86.00	¥79.00	¥83.00
SAP	€0.682	€0.716	€0.758	€0.721	€0.777	€0.725
Volkswagen	€0.680	€0.718	€0.754	€0.719	€0.778	€0.753
Canon	¥91.00	¥92.00	¥81.00	¥78.00	¥87.00	¥105.00
Philips	€0.7096	€0.6945	€0.7485	€0.7728	€0.7582	€0.7255
Hyundai	₩1098.71	₩1274.63	₩1155.74	₩1106.94	₩1126.45	₩1094.67
Siemens	€0.664	€0.735	€0.736	€0.715	€0.767	€0.74
Sony	¥103.39	¥93.68	¥87.78	¥79.70	¥79.82	¥97.63

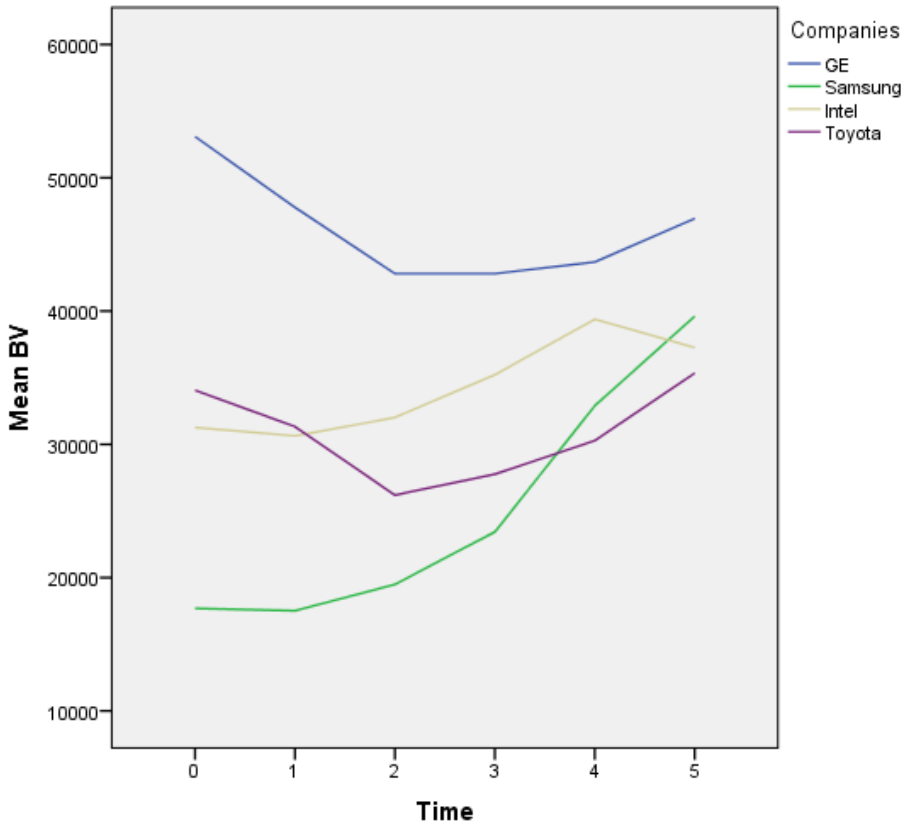
Nintendo	-	-	¥87.78	-	-	-
Audi	€0.680	€0.717	€0.754	€0.718	€0.778	€0.725
Porsche	€0.680	€0.718	€0.754	€0.719	€0.778	€0.753
Panasonic	¥103.39	¥93.68	¥87.78	¥79.70	¥79.82	¥97.63
Ferrari	€0.680	€0.718	€0.754	€0.719	€0.778	€0.780
Nokia	€0.680	€0.718	€0.754	€0.719	€0.778	€0.753
L’Oreal	€0.680	€0.718	€0.754	€0.719	€0.778	€0.753

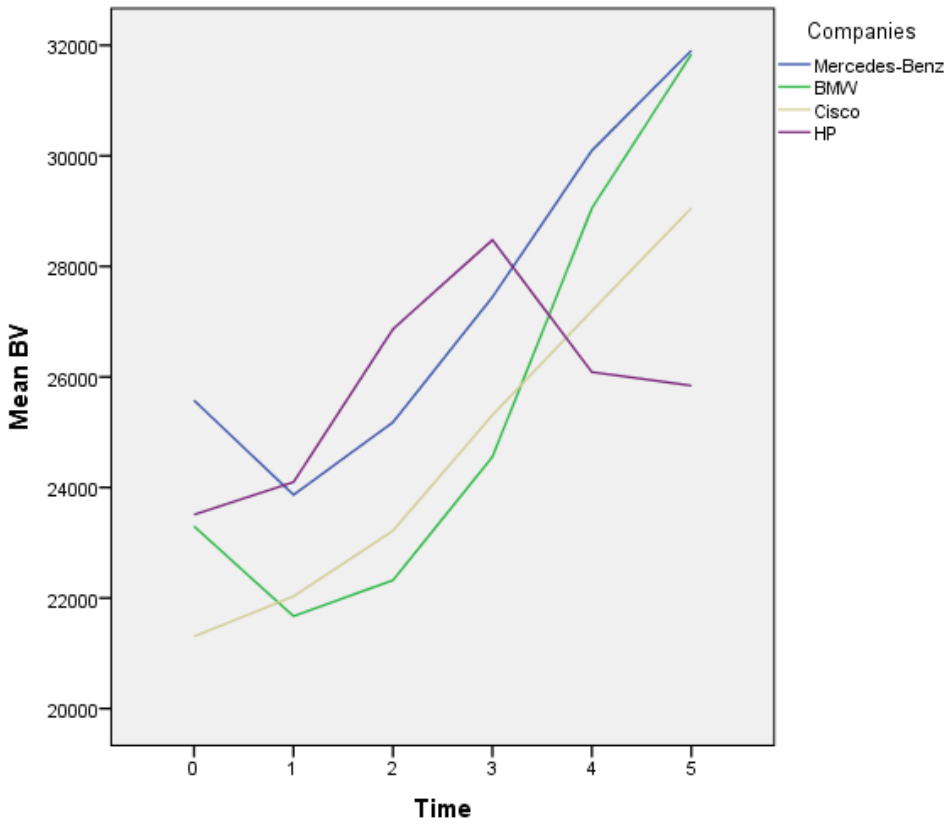
Appendix 7. Descriptive statistics for independent and dependent variables

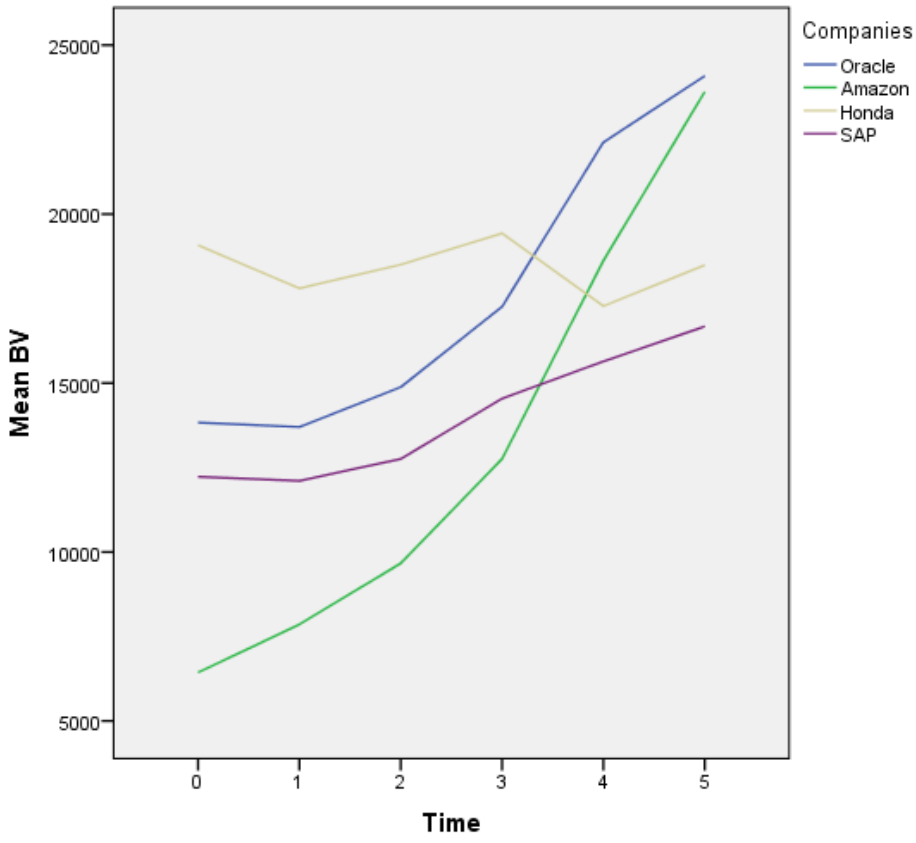
	N	Minimum	Maximum	Mean	Std. Deviation
Advertising	143	$71.0	$20,460.1	$3,087.460	$3,366.0235
R&D	213	$136.2	$15,595.0	$4,097.303	$2,917.6713
R&D intensity	213	1.00	20.61	6.9498	4.24177
NPD	216	4	40448	4087,46	5755,407
Design	216	3.0	4.2	3.644	.3093
Brand value	216	3281	98316	19104,19	18227,919
Brand value (primary data)	216	3.27	4.33	3.7439	.32475

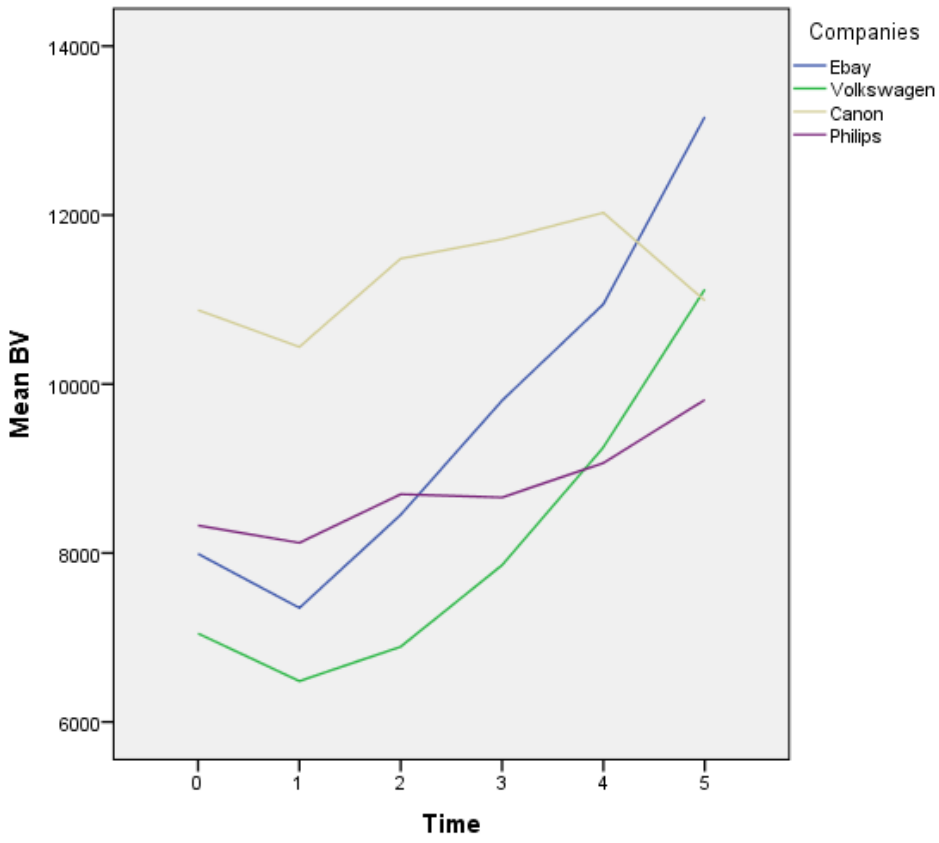
Appendix 8. Brand value within observation period

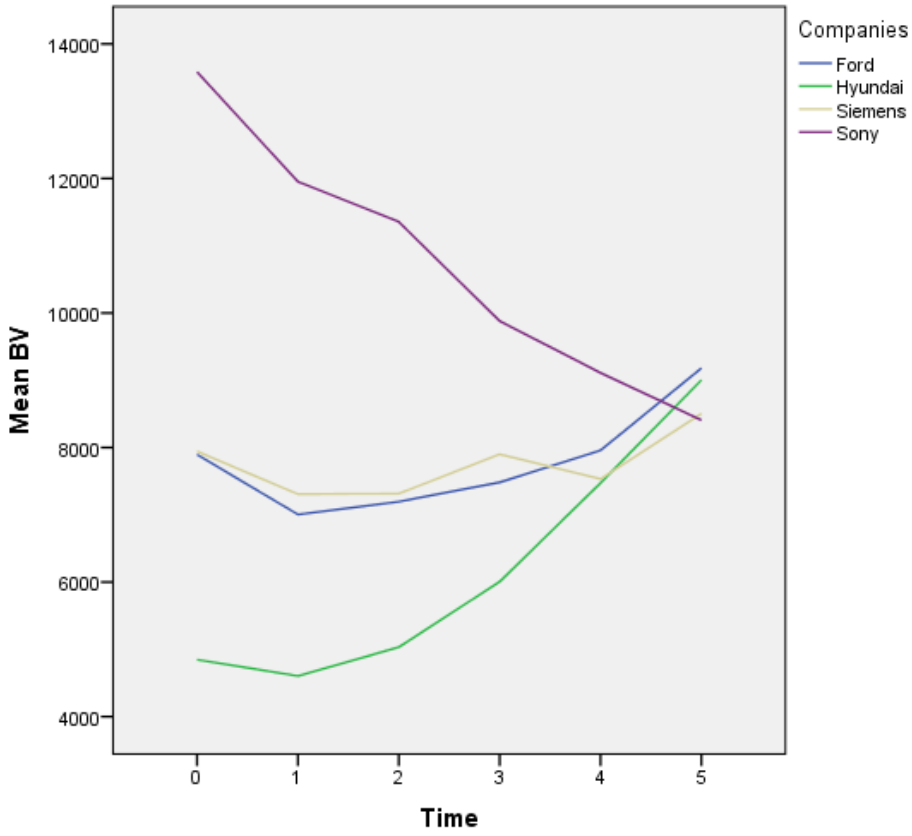


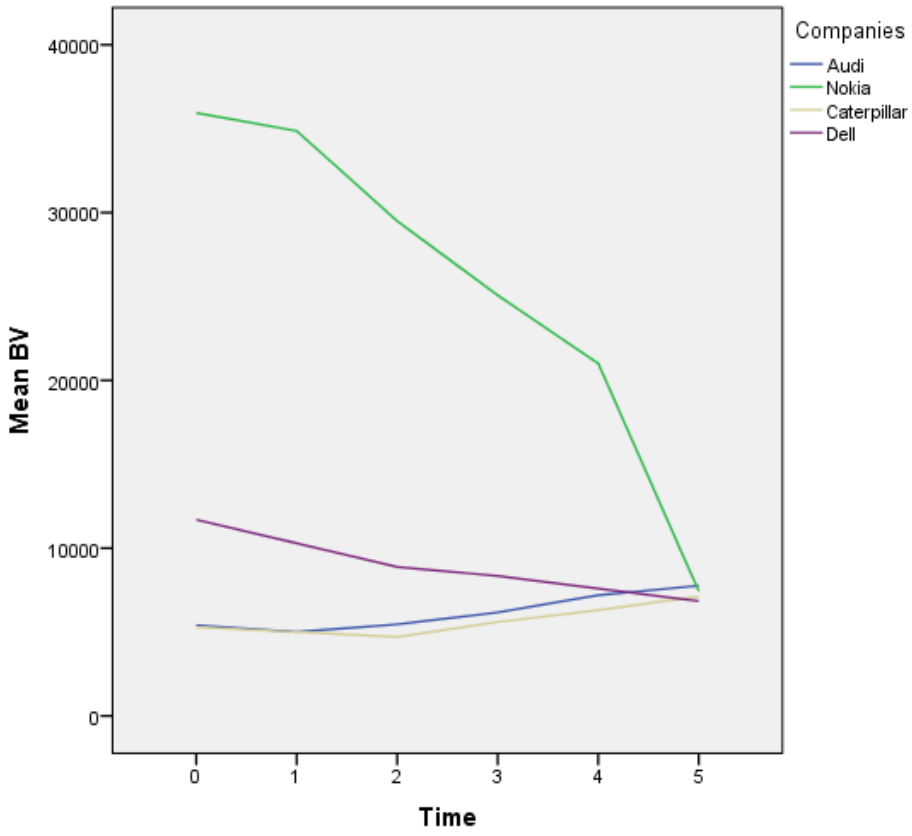

Companies
GE
Samsung
Intel
Toyota
Mean BV
60000
50000
40000
30000
20000
10000
0
1
2
3
4
5
Time

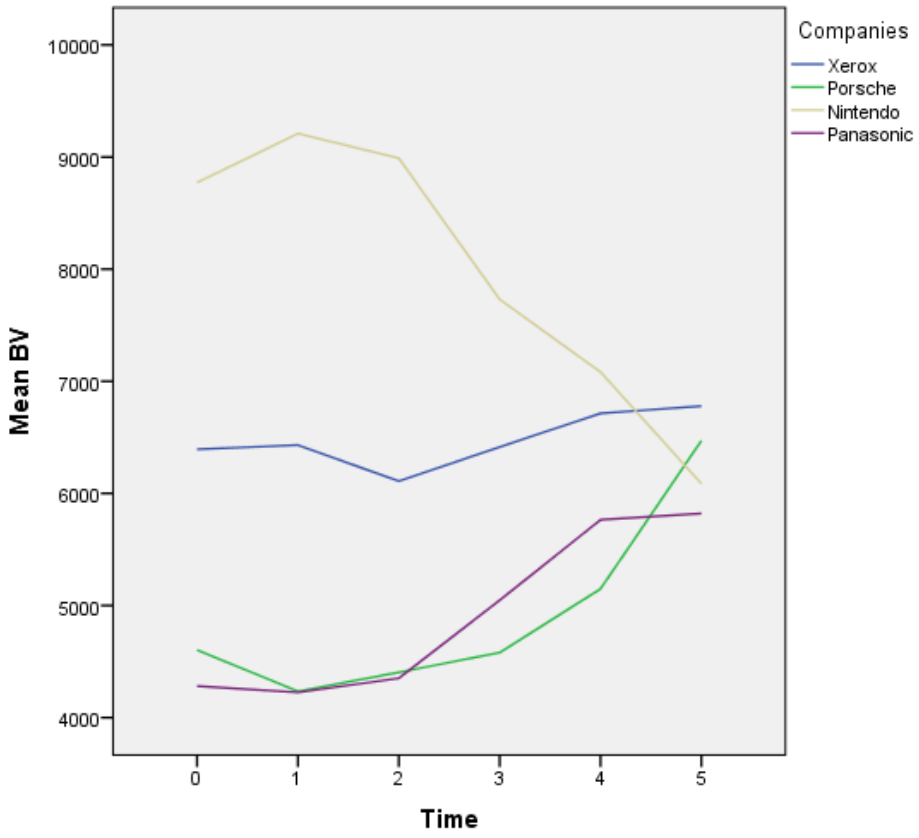

Companies
Mercedes-Benz
BMW
Cisco
HP
Mean BV
32000
30000
28000
26000
24000
22000
20000
0
1
2
3
4
5
Time

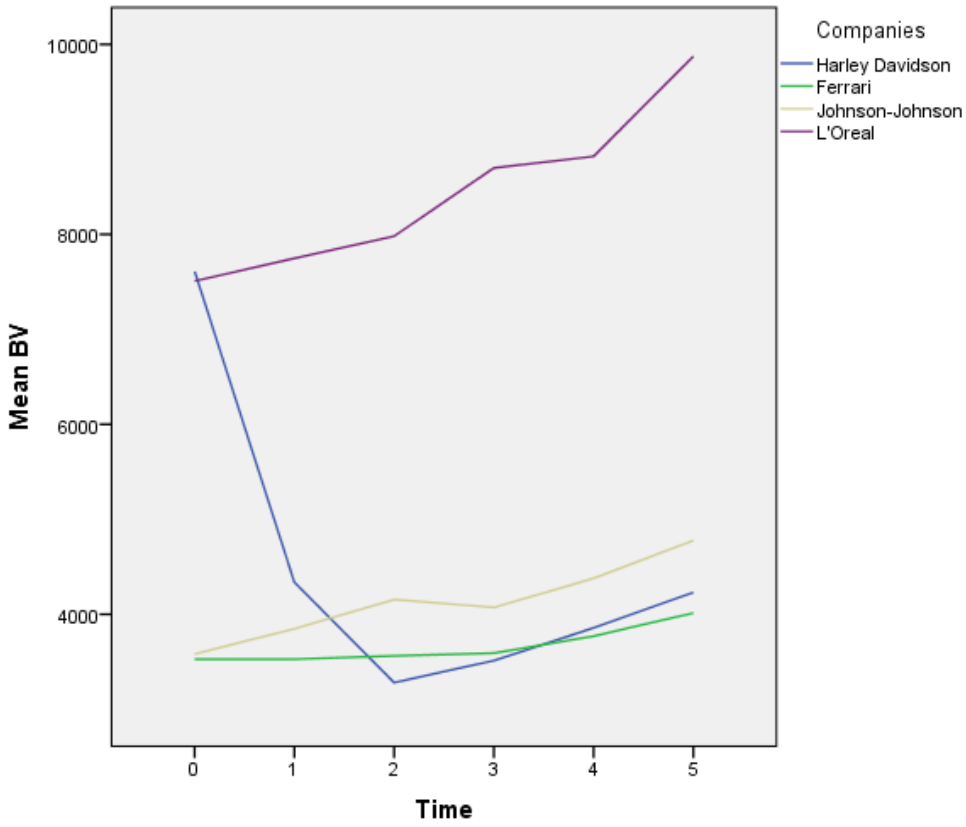

Companies
Oracle
Amazon
Honda
SAP
Mean BV
25000
20000
15000
10000
5000
0
1
2
3
4
5
Time


Companies
Ebay
Volkswagen
Canon
Philips
Mean BV
14000
12000
10000
8000
6000
0
1
2
3
4
5
Time

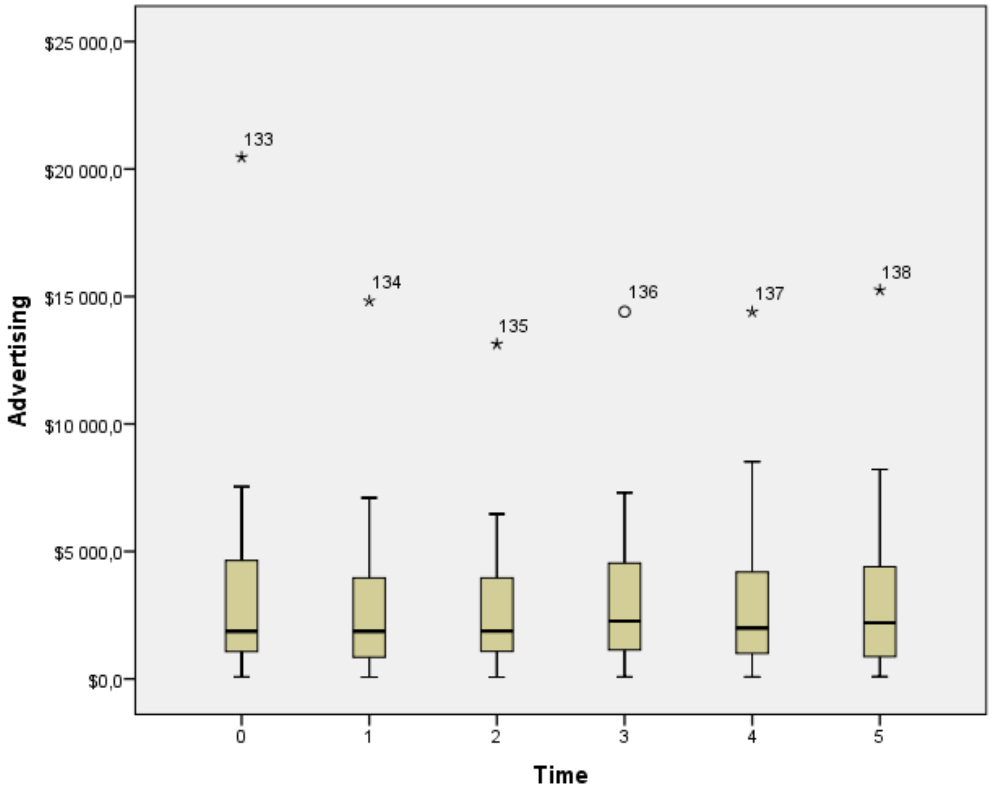

Companies
Ford
Hyundai
Siemens
Sony
Mean BV
14000
12000
10000
8000
6000
4000
0
1
2
3
4
5
Time

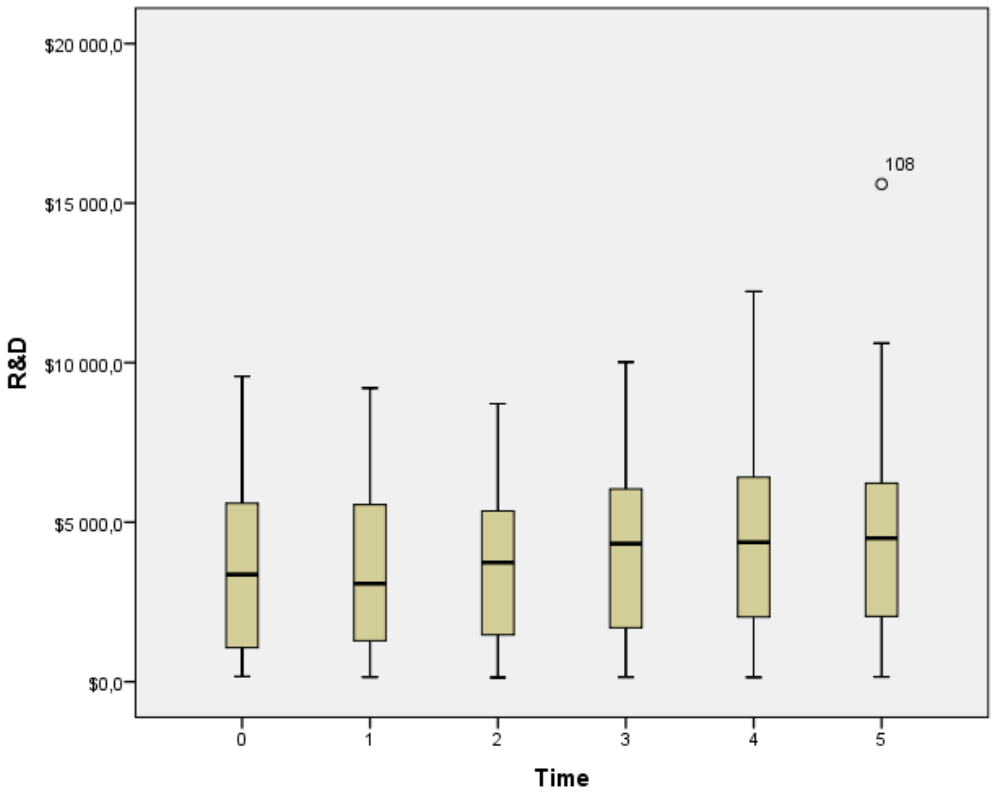

Companies
Audi
Nokia
Caterpillar
Dell
Mean BV
40000
30000
20000
10000
0
0
1
2
3
4
5
Time

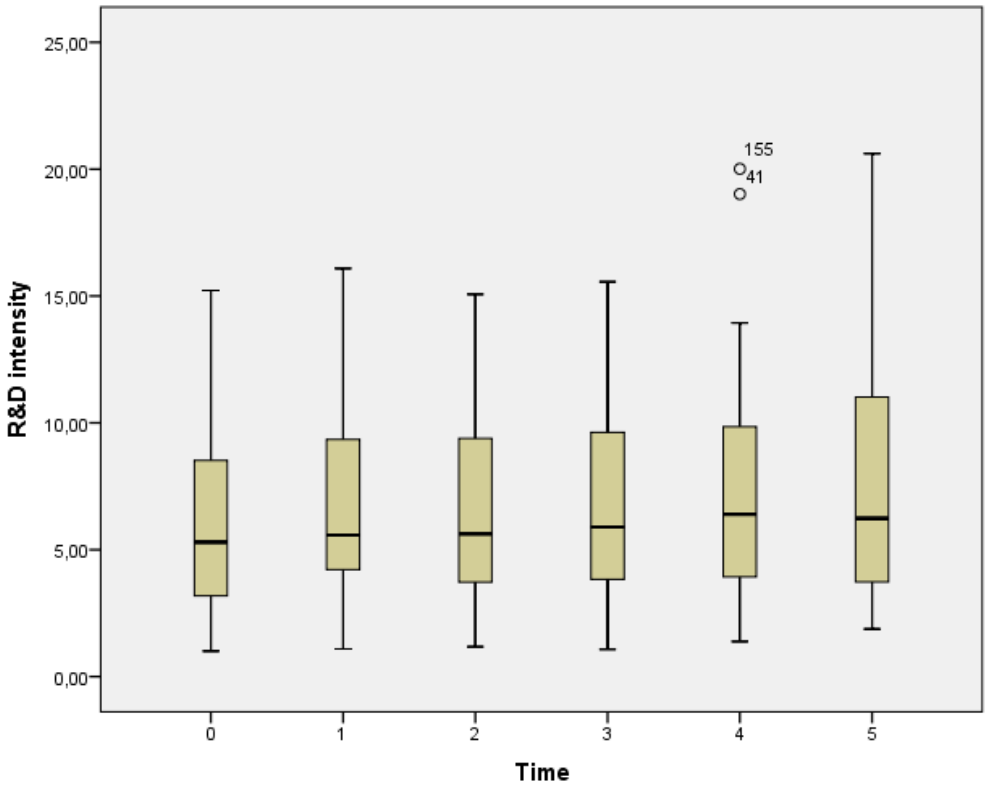

Companies
Xerox
Porsche
Nintendo
Panasonic
Mean BV
10000
9000
8000
7000
6000
5000
4000
0
1
2
3
4
5
Time

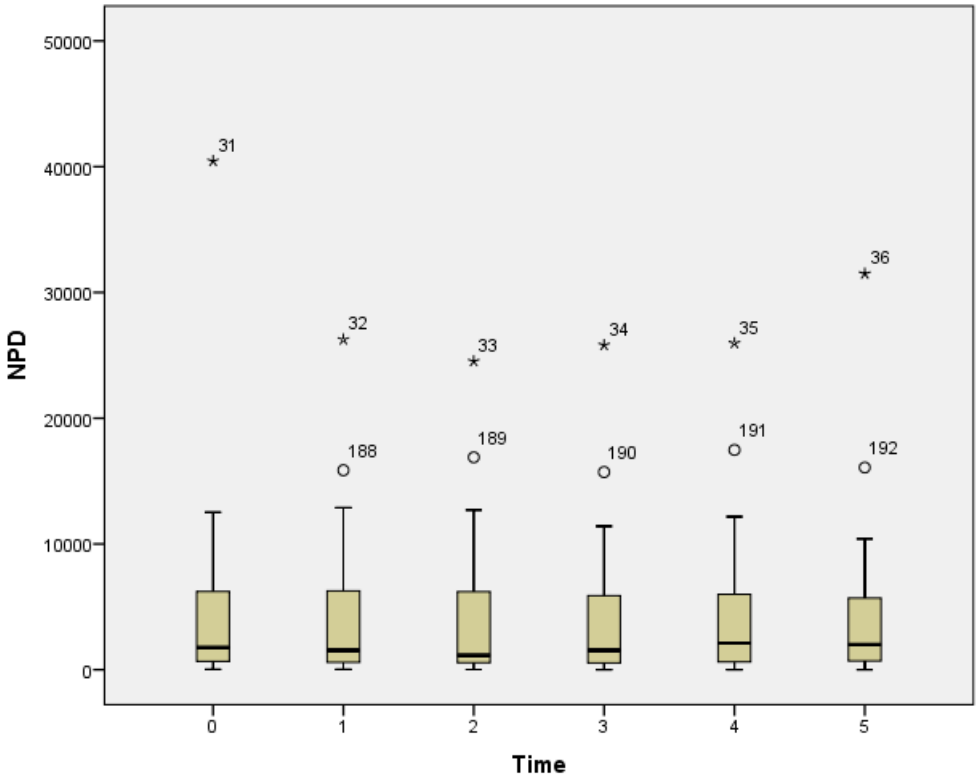

Companies
Harley Davidson
Ferrari
Johnson-Johnson
L'Oreal
Mean BV
10000
8000
6000
4000
0
1
2
3
4
5
Time

Appendix 9. The values of advertising expenditures, R&D expenditures, R&D intensity and NPD






R&D intensity
25,00
20,00
15,00
10,00
5,00
0,00
155
41
0
1
2
3
4
5
Time


NPD
50000
40000
30000
20000
10000
0
31
32
33
34
35
36
188
189
190
191
192
0
1
2
3
4
5
Time

Appendix 10. Hausman test results for *advertising expenses* and *R&D expenses, R&D intensity and NPD*

	Coefficients			
	(b) fix	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
L.Adv	4.421959	2.028545	2.393414	.6290119

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 14.48
Prob>chi2 = 0.0001

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
RnD L1.	5.29569	4.489322	.8063685	.3492382

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 5.33
Prob>chi2 = 0.0209

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
RnD_int L1.	-465.4993	67.49413	-532.9935	318.1957

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 2.81
Prob>chi2 = 0.0939

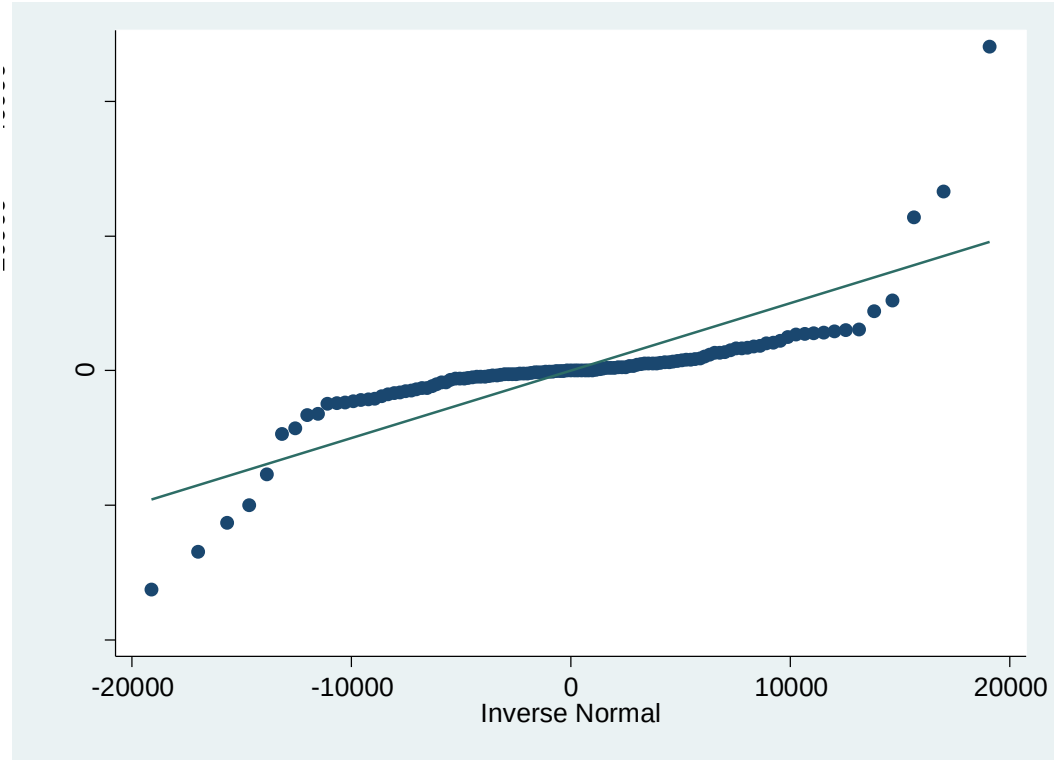
	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
NPD L1.	.095111	.2697592	-.1746482	.2505188

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

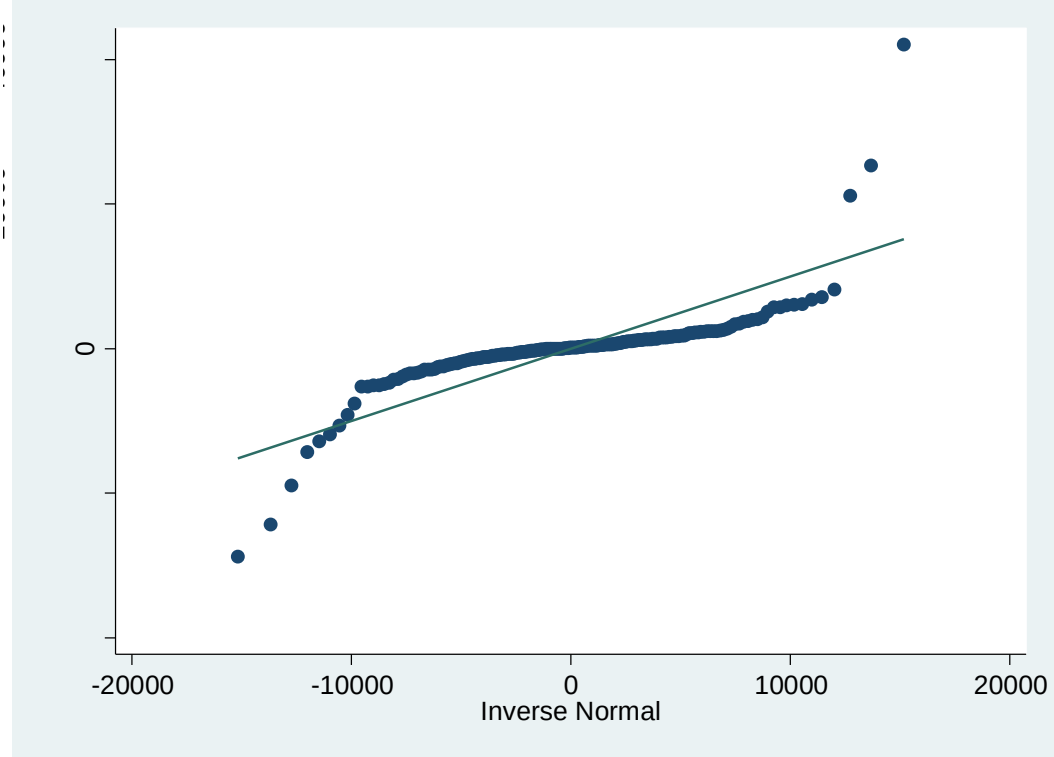
Test: Ho: difference in coefficients not systematic

chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 0.49
Prob>chi2 = 0.4857

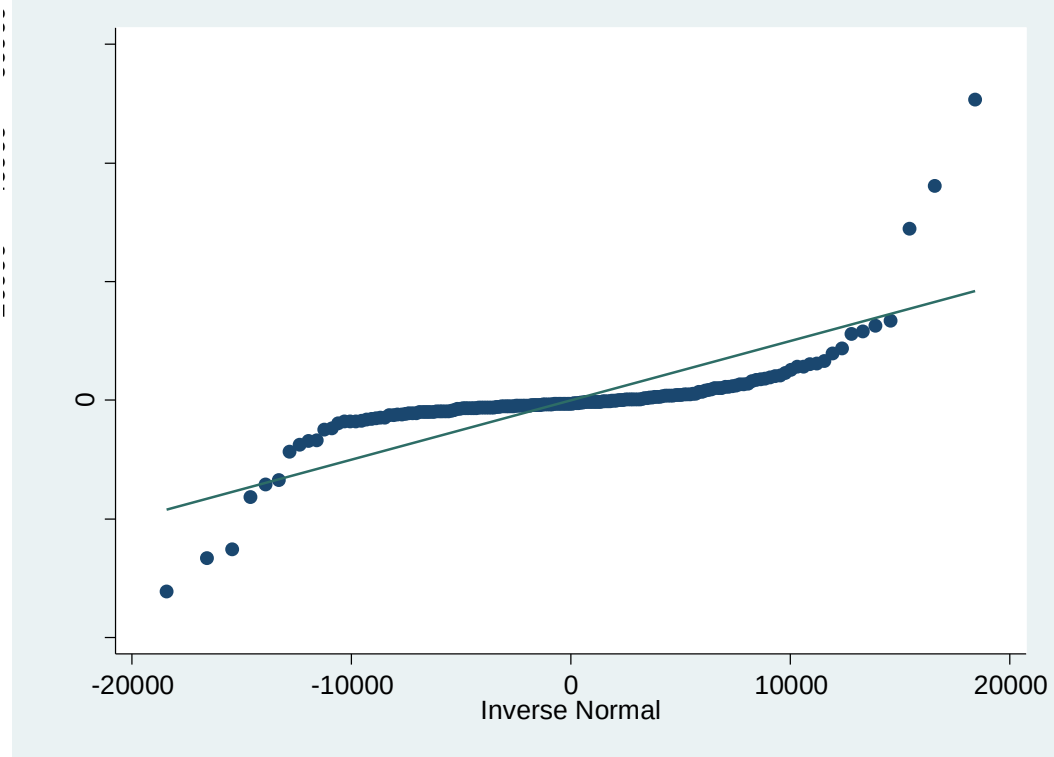
Appendix 11. Q-Q plots of residuals



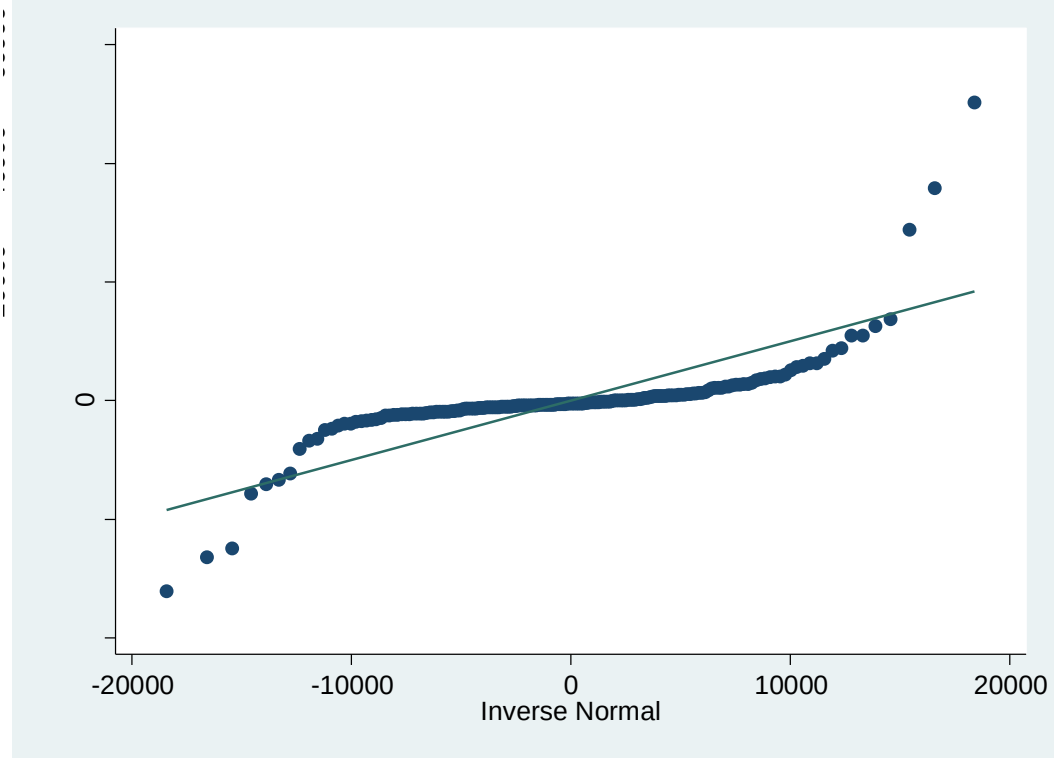
The model with incorporated one year lagged advertising expenditures.



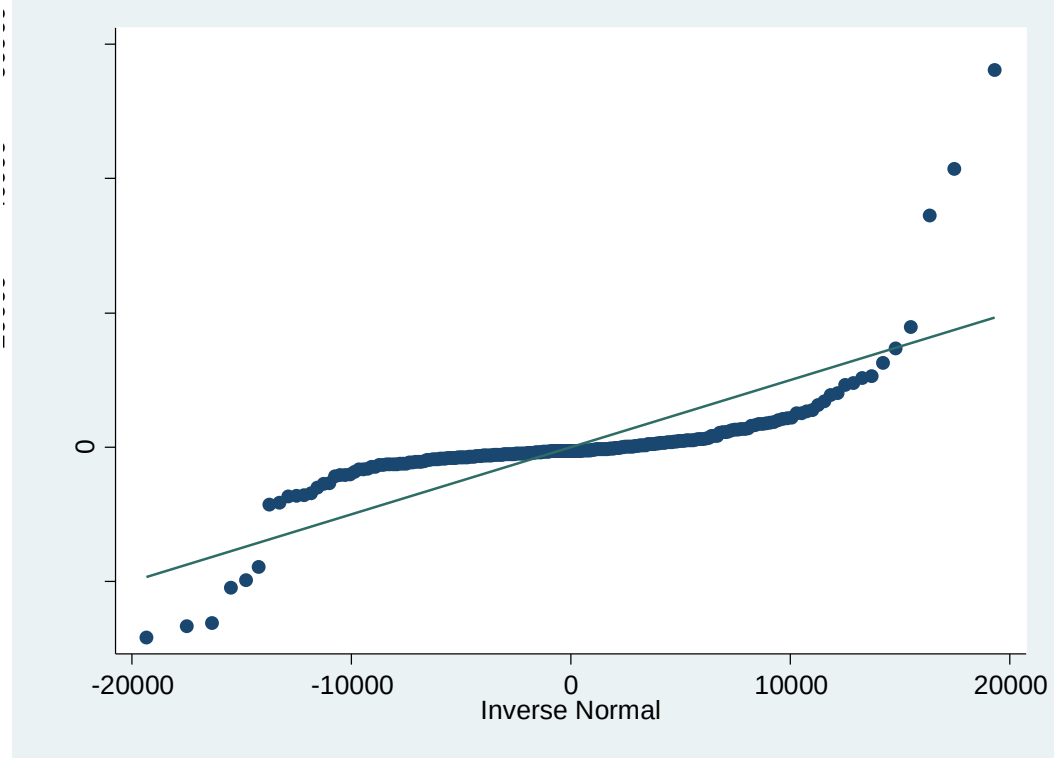
The model with incorporated one year lagged R&D expenditures.



The model with incorporated one year lagged R&D intensity.



The model with incorporated one year lagged NPD.



The model with incorporated design evaluation.