The influence of industries on SMEs' engagement in eco-design practices

An empirical analysis of the service sector in Europe

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Abstract

This thesis contributes by analyzing eco-design practices of SMEs in the service sector and its industries across Europe. Two types of eco-design practices are distinguished: offering of eco-design products and services and investments in eco-design processes (resource efficiency). The service sector is identified as less likely to adopt eco-design practices, due to relatively low resource intensities, marginal financial incentives and a low visibility. However, the service sector represents a high potential in decreasing environmental degradation due to an increased use of natural resources. Also, the service sector is the largest sector in Europe in terms of GDP. Furthermore, the focus on SMEs is important. Previous research mainly examines eco-design practices performed by MNCs. However, SMEs produce 60 to 70% of total pollution in the EU. It is important to get insights in the way SMEs behave in the field of eco-design practices in order to decrease environmental degradation. Also, stimulating the adoption of eco-design practices by implementing focused regulation and policies is important. Regulation nowadays has to be approved by the EU. To provide recommendations for focused regulation and policies, it is important to perform cross-country analyses.

By using data for over 5,600 SMEs across 12 sectors in Europe, this study tests hypotheses regarding the service sector and the following industries within the service sector: Accommodation, Transport and Financial. The results indicate that SMEs active in the service sector are indeed less likely to engage in eco-design practices compared to other sectors. Industry-specific analyses show no significant differences between the industries of interest regarding eco-design processes. It could be that resource intensities differences within the service sector are not large enough in order to provide additional financial incentives. The results are consistent to the expectations regarding eco-design products and service offerings. SMEs active in the Accommodation industry are most likely to engage in eco-design products and services, followed by SMEs active in the Transport industry. The Financial industry is least likely to engage in eco-design products and services, as hypothesized.

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1. Introduction

The consumer and capital market for green products, services and firms has expanded rapidly in the last decade. Green products and services are defined as sustainable, environmental-friendly, easily recycled and tend to avoid excessive inputs of energy for production (Centre for Retail Research [CRR], 2012). Sales in green products throughout Europe already increased from €10.3 billion in 2000 to €56 billion in 2009 and sales are expected to more than double to €114 billion in 2015 (CRR, 2012). Around 26% of EU citizens often buy environmentally-friendly products, 54% of them sometimes do (Eurobarometer 367, 2013).

Besides offering green products and services, firms invest in "greening" their processes as well. Firms can perform various activities to become more resource efficient, such as using renewable energy and minimizing waste. Firms have several incentives for becoming more resource efficient, for instance: regulatory pressure, competitiveness improvement, cost reductions and the corporate image (Rademaekers et al. 2011; Simpson et al., 2004). Governments, institutions and stakeholders are stimulating (and subsidizing) sustainable and environmental-friendly projects. An example of regulatory pressure: the EU set ambitious climate and energy targets for 2020, also known as "20-20-20" targets.[1]

Firms notice that consumers and governments' demands are shifting towards environmental-friendly products and services. In response, many firms engage in reactive and proactive environmental practices. Reactive environmental practices focus at complying with governmental regulations and nothing more (Sarkis et al., 2012). Proactive environmental practices go beyond compliance, by interpreting environmental issues as opportunities (Sharma, 2000). This research focuses on a part of proactive environmental practices: eco-design practices. Eco-design practices consist of both the offering of eco-design (green) products and services and investments in eco-design processes (resource efficiency).

Previous literature mainly examines eco-design practices performed by multinational corporations (MNCs), resource-intensive industries and individual countries. This research makes the following contributions by analyzing eco-design practices of SMEs in the service

[1] *20-20-20 targets*
- 20% reduction in EU Greenhouse Gas Emissions from 1990
- 20% increase in share of EU energy consumption produced from renewable sources
- 20% improvement in the EU's energy efficiency

sector and its industries across Europe.

First, much research has been done on MNCs adopting eco-design practices, due to higher public pressure (Christmann, 2004; Rondinelli, 2004; Perinni, 2006). As a result, the drivers of eco-design practices for small and medium-sized enterprises (SMEs) remain underexposed (Williamson et al., 2006). There are over 23 million SMEs in the EU and only 41,000 large companies. The EU defines SMEs as firms employing 1 to 250 people and representing a turn-over less than €50 million (Gagliardi et al., 2013).[2] This research defines SMEs in number of employees. SMEs are the driving force behind the European economy, accounting for approximately 70% of EU jobs and GDP (European Commission, 2008). However, SMEs also produce 60 to 70% of total pollution in the EU (Labonne, 2006; Aragon-Correa et al., 2008). Therefore, it is important to get insights in the way SMEs behave in the field of eco-design practices to decrease environmental degradation.

Second, besides the focus on MNCs, previous literature mainly analyzed resource-intensive sectors and its efforts to engage in eco-design practices. Resource-intensive sectors are interesting since they have a substantial impact on the environment and find strong financial and regulatory incentives to adopt environmental practices (Rademaekers et al., 2011; Schleich and Gruber, 2008; Orsato, 2006; Williamson, 1991). However, resource-intensive sectors already made substantial improvements in adopting environmental practices (Rademaekers et al., 2011). As a result, other sectors, where there may be more room for improvement, remain underexposed. The service sector is identified as one of those sectors falling behind on engagement in eco-design practices (Grove et al., 1996; Simpson et al., 2004), whilst environmental impact enlarges due to the increased use of natural resources (Constantinos et al., 2010; Grove et al., 1996; Mairet and Decellas, 2009). The trend showing an increased impact on the environment, together with a low visibility regarding the impact of operations on the environment (Grove et al., 1996), classify the service sector as a high potential to decrease environmental degradation. In addition, the service sector is regarded as the largest sector within the EU, accounting for over 70% of total gross value (Eurostat, 2012). Gross value added accounts for more than 90% of GDP. Furthermore, Groove et al. (1996) find severe differences between industries within the service sector regarding the adoption of environmental practices. This finding addresses the need for an industry-specific analysis within the service industry.

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[2] *SME definition:*
- Micro firms: <10 employees and < €2 million turn-over.
- Small firms: <50 employees and < €10 million turn-over.
- Medium-sized firms: <250 employees and < €50 million turn-over.

Third, previous research mainly examines environmental performance within individual countries (Revell and Blackburn, 2007; Zhu et al., 2007; Lawrence et al., 2006). It is important to get insights in the way SMEs behave throughout the EU, in order to provide recommendations for focused regulation, which nowadays have to be approved by the EU.

Fourth, this research focuses on two main aspects of environmental performance by SMEs: offering of eco-design products and services and investments in eco-design processes (resource efficiency). By analyzing two types of eco-design practices, this research investigates whether SMEs' engagement differs across types of eco-design practices.

The objective of this thesis will be to examine the influence of industries within the service sector on SMEs' engagement in eco-design practices. Since little is known about the engagement of SMEs in eco-design practices, the nature of this research will be mainly exploratory. Analyzing the service sector and its industries is a broad first step into determining what characteristics are influencing SMEs to engage in eco-design practices. This research will be a first step towards advice for policy makers by identifying which SMEs active in the service sector are less likely to engage in eco-design practices. Furthermore, governments can also adopt strict legislation to force certain SMEs into engagement in eco-design practices. It is mainly interesting to compare industries within the service sector and to provide recommendations to properly address industries which are less likely to engage in eco-design practices.

This research forms hypotheses for the following industries within the service sector: Financial industry, Transport industry and Accommodation industry. Hypotheses for eco-design processes are based on resource intensity. Hypotheses for eco-design products and service offering are based on previous research. By analyzing over 5600 SMEs across 12 sectors in Europe, it is possible to test the hypotheses regarding the service sector. Over 1400 SMEs active in the service sector across Europe represent the sample to test the hypothesis regarding the individual industries within the service sector. The data is retrieved from the Flash Eurobarometer Survey (no. 342) on "SMEs, resource efficiency and green markets".

The findings under scribed the importance of the service sector to decrease environmental degradation. The service sector is indeed less likely to engage in eco-design practices compared to other sectors. There seems to be no difference between industries within the service sector regarding eco-design processes in order to become more resource efficient.

However, the Financial industry is less likely to engage in eco-design products and services compared to other industries. This finding addresses the need to stimulate SMEs in the Financial industry to engage in eco-design products and services.

The remainder of this thesis is organized as follows: the second section of the thesis provides the literature background. Afterwards, hypotheses are formed in the third section. The data and methodology are elucidated in the fourth section. The fifth section shows the results. Lastly, the discussion is held in the sixth section.

2. Literature background

An introduction into environmental practices and SMEs is presented in the first section. In the second section, eco-design practices will be explained. In the third section, the importance of sectors and industries and firm characteristics will be elucidated. Finally, resource-intensive sectors will be discussed in the fourth section.

2.1 Introduction environmental practices and SMEs

Environmental practices are actions undertaken by a firm to reduce the environmental impact of their operations (Gadenne et al., 2009). Although this definition is widely interpretable, several studies use this definition to describe these practices (Hoogendoorn et al., 2014, Uhlaner et al., 2012). Sarkis et al. (2010) categorize environmental practices in different dimensions, ranging from reactive to proactive practices.

Reactive environmental practices

Reactive environmental practices focus at meeting governmental regulations regarding environmental performance (Sarkis et al., 2010; Schot and Fischer, 1993). Firms do not go beyond this scope of minimum requirements, and many would not even address environmental issues in the absence of regulation (Buysse and Verbeke, 2003). Firms with reactive environmental practices are committing limited resources to solving environmental problems (Hart, 1995). Buysse and Verbeke (2003) state that limited resources are made available, since stakeholder actions in response to poor environmental performance are not perceived as a threat to the (financial) performance of the firm.

Proactive environmental practices

Proactive environmental practices go beyond compliance with governmental regulations, by interpreting environmental issues as opportunities (Sharma, 2000; Andersson and Bateman, 2000). Proactive environmental practices consist of eco-design, source reduction and overall managerial process management (Table 1). Eco-design practices focus on developing products and processes that have minimal impact on the environment. Source reduction practices are mainly aimed at preventing pollution of operational processes on the short-term. Overall managerial process management practices are considered as the broader environmental perspective a firm pursues. Those practices are closely related to the implementation of an Environmental Management System (EMS) within an organization.

EMS is the documentation of environmental performance, primarily focused on design, pollution control, waste minimization and setting goals (Melnyk et al., 2013).
Early research states that larger firms are more likely to engage in proactive environmental practices (Aragón-Correa, 1998: Russo and Fouts, 1997; Sharma, 2000). Many scholars believe that the need for complex coordination of skills and extensive resources are the main reasons that SMEs are less likely to adopt proactive environmental practices (Russo and Fouts, 1997; Ramus and Steger, 2000; Shrivastava, 1995; Greening and Gray, 1994). Although the arguments intuitively make sense, empirical evidence is not found (Aragón-Correa et al., 2008). Based on this intuitive assumption, further research regarding SMEs and environmental practices mainly focuses on reactive environmental practices (Rutherfoord et al., 2000; Schaper, 2002; Williamson and Lynch-Wood, 2001). However, in the late 2000s, Aragón-Correa et al. (2008) introduce new evidence, proving that SMEs are able to behave proactive regarding environmental practices.

Proactive environmental practices and SMEs

Aragón-Correa et al. (2008) show, contrary to previous research, that SMEs can adopt proactive environmental practices. Extensive resource capacity is not necessarily a condition for the development of proactive environmental practices. Furthermore, a complex coordination of skills from an organizational point of view is neither influenced by firm size, as another research by Flannery and May (2002) confirms. Traditional arguments that SMEs only focus on engagement in reactive environmental practices have to be revised. Earlier research followed up on the assumption that SMEs do not engage in proactive environmental practices (Rutherfoord et al., 2000; Schaper, 2002; Williamson and Lynch-Wood, 2001), while not being proven (Aragón-Correa et al., 2008). This resulted in a lack of literature concerning SMEs and its engagement in proactive environmental practices (Aragón-Correa et al., 2008; Williamson et al., 2006). Only a few descriptive studies have shown that SMEs can successfully implement proactive environmental practices (Bianchi and Noci, 1998; Carlson-Skalak, 2000; Hillary, 2000). Aragón-Correa et al. (2008) build on their work and find SMEs engaging in proactive environmental practices to show better financial performance. Their findings are confirmed by several other studies stating that proactive environmental practices are associated with cost savings, improved reputation and new organizational capabilities, all leading to competiveness improvement (Christmann, 2000; Hart, 1995; Sharma and Vredenburg, 1998). Building on the work of Aragón-Correa et al. (2008) this research will focus on proactive environmental practices of SMEs. This topic is highly relevant, due to a lack of existing literature. Early research mainly focused on reactive environmental practices. Furthermore, proactive environmental practices reduce the impact on the environment more than reactive environmental practices (Tukker et al., 2001; Jeswiet and Hauschield, 2005). Thus, it is important for policy makers to stimulate SMEs into engagement in proactive environmental practices. Furthermore, governments can adopt strict legislation forcing SMEs to engage in proactive environmental practices. SMEs also have a financial incentive to engage in proactive environmental practices, this may be an important argument for policy makers to convince SMEs. More specifically, eco-design practices will be analyzed. Eco-design practices are part of proactive environmental practices, as can be seen in Table 1. In the next subsection, the choice for eco-design practices will be explained.

Environmental practices			
Proactive environmental practices			**Reactive environmental practices**
Eco-design practices	Source reduction practices	Overall managerial process management	Minimum regulatory requirements

Table 1: Eco-design practices

2.2 Eco-design practices

Eco-design has been defined as "the systematic integration of environmental considerations into product and process design" (National Resource Council, Canada, 2003). Eco-design practices focus on developing products and processes that have minimal impact on the environment (Sarkis et al., 2010). Literature is conclusive about the fact that eco-design practices have the largest environmental impact in relation to other proactive environmental practices. Tukker et al. (2001) state that eco-design is currently seen as the most important part of environmental policy. Jeswiet and Hauschild (2005) confirm their findings by stating that eco-design is the most important phase in the life of a product or service, where decisions will have the largest environmental impact. Furthermore, improving the design of products bears the promise of reaching environmental targets set by EU (Tukker et al., 2001). Therefore, this research will focus on eco-design practices. Eco-design practices consist of eco-design products and eco-design processes.

Eco-design products

The focus on products, besides process innovation, provides major opportunities for substantial increases in eco-efficiency (Tukker et al., 2001). In terms of product design, the environmental impact helps to define the direction of decisions (Brezet, 1997). Bauman et al. (2002) state that eco-design is forced into firms' strategies by consumers expressing an environmental concern since the beginning of the 1990s. As a result, eco-design products are developed with the expectation to be environmentally superior to traditional products but also competitive in terms of price and technical performance (Porter and van der Linde, 1995; Elkington 1994). Furthermore, competitive advantage through product or service differentiation, better service of niche markets and the improved image and loyalty of stakeholders are important additional benefits for the development of eco-design products and services (Shrivastava, 1995; Goodman, 2000; Rondinelli and Vastag, 1996). Uhlaner et al. (2012) take the process of producing, selling and searching for environmentally friendly products for a firm into account as measures for environmental practices. Hoogendoorn et al. (2014) also find offering of eco-design products to be a key element of environmental practices.

Eco-design processes

In the definition by National Resource Council Canada (2003), the integration of environmental considerations into process design for firms plays a crucial role. Eco-design considers environmental aspects at all stages of the product development process and throughout the product life cycle (Brezet, 1997; van Hemel and Brezet, 1997). Eco-efficiency, or resource efficiency, is seen as one of the key indicators of eco-design during this life cycle (Aoe, 2006). To identify various eco-design processes, van Hemel and Brezet (1997) developed the eco-design strategy wheel. Eco-design processes are categorized as follows: selection of low impacts materials, reduction of materials usage, optimization of production techniques, optimization of distribution system, reduction of impact during use, optimization of initial lifetime and optimization of end-of-life system. Eco-design processes taken into account throughout this research comply with the eco-design strategy wheel. Resource efficiency is the key indicator for eco-design processes. Such eco-design practices include for instance the use of recycled materials, renewable energy and the minimization of waste. Russo and Fouts (1997) examine for example waste reduction, while Stanwick and Stanwick (1998) focus on pollution reduction with renewable energy sources. Hoogendoorn et al. (2014) take into account to which extent a firm invests in resource efficiency.

2.3 Sectors, industries and firm characteristics

The first subsection will discuss the importance of sectors and industries. The second subsection will elucidate firm characteristics.

2.3.1. Sectors and industries

This thesis examines the influence of industries within the service sector on SMEs' engagement in eco-design practices. This research identifies sectors and industries based on the NACE classification code. Group characteristics and behavior in a sector or industry might be important in determining whether a firm will engage in eco-design practices. So far, previous research mainly focused on the engagement of eco-design practices for MNCs (Christmann, 2004; Rondinelli et al. 2004; Perinni, 2006), in single resource-intensive sectors (Rademaekers et al., 2011; Schleich and Gruber, 2008; Orsato, 2006; Williamson, 1991) and in individual countries (Revell and Blackburn, 2007; Zhu et al., 2007; Lawrence et al., 2006). This thesis compares the extent to which SMEs engage in eco-design practices for three industries within the service sector: Financial and insurance activities, Accommodation and food service activities and Transportation and storage.

The most common way to identify a sector is based on its industries. An industry is defined as a group of firms that operate in the same segment of the economy (Langager, 2009). This research will use NACE coding to identify sectors and industries, a statistical classification of economic activities in the European Community. To illustrate, the manufacturing sector (NACE C) consists of various industries, such as manufacture of food products (NACE C10), manufacture of textiles (NACE C13) and manufacture of chemicals (NACE C20). By using NACE coding, firms get assigned to a certain sector and a certain industry, based on its economic activities. More information on NACE coding will be elaborated in chapter four.

2.3.2. Firm characteristics

Besides grouping firms by sector and industry, it is also possible to distinguish between firms on several other characteristics. Firm characteristics taken into account throughout this research are as follows: level of compliance, the implementation of EMS, firm size and firm age. Firms pursue eco-design practices in different levels of commitment. Montiel (2008) finds firms that are socially responsible to have a higher probability to implement pollution prevention techniques and recycling programs. Therefore, this research takes the level of compliance for a firm into consideration. The level of compliance is closely related to the level of Corporate Social Responsibility (CSR). CSR is defined as “the responsibilities that embody those standards, norms or expectations that reflect a concern for what consumers, employees, shareholders and the community regard as fair, just, or in keeping with the respect of protection of stakeholders’ moral rights” (Carroll, 1999; Driffield et al., 2013). The CSR theory claims that the firm’s purpose of existence is to offer appreciated services to society (Preuss, 2010). Previous literature states that a firm pursues CSR when it goes beyond compliance (Rodriguez et al. 2006; McWilliams & Siegel, 2001). Earlier this chapter, proactive environmental practices are defined as ‘going beyond compliance’ (Sharma, 2000; Andersson and Bateman, 2000). Many researchers confirm the finding that environmental practices are a subset of social practices (Graves and Waddock, 1994; Turban and Greening, 1997). CSR seems to induce proactive eco-design practices for a given firm. More information on firm size and firm age will be elaborated in chapter four.

2.4 Sectors and eco-design practices

Hoogendoorn et al. (2014) take the first step into analyzing SMEs’ performance regarding eco-design practices on cross-sector level. This paper finds that firms operating in a sector characterized by tangible products show the highest probability of engagement in eco-design processes. Hoogendoorn et al. (2014) combine the following sectors into the tangible products sector: Manufacturing, construction, mining and quarrying, electricity, gas, steam and air conditioning and water supply, sewerage and waste management. However, since Hoogendoorn et al. (2014) combined many sectors into a tangible products sector, there might exist severe differences within this overarching sector. The tangible products sector, used by Hoogendoorn et al. (2014) consists of many resource-intensive sectors. The next paragraph will elucidate why resource-intensive sectors are more likely to engage in eco-design processes.

Resource-intensive sectors

Much research has been done examining the influence of resource-intensive sectors on the environment (UNEP, 2010; Rademaekers et al., 2011). A report from UNEP (2010) finds resource-intensive sectors to have a considerable impact on resources and environment. However, the literature is conclusive about the fact that resource-intensive sectors already made substantial improvements by implementing eco-design practices, for regulative reasons (Rademaekers et al., 2011) as well as financial reasons (Schleich and Gruber, 2008; Orsato, 2006; Williamson, 1991).

The following sectors are identified as resource-intensive: building & construction, agriculture & food and metal & manufacturing (Rademaekers et al., 2011). For example, the agriculture sector alone makes up for 70% of the world's freshwater consumption and 14% of greenhouse gas emissions. The Shift Project Data Portal confirms the considerable impact on environment by resource-intensive sectors. For example, the manufacturing and construction sector account for 17% of total GHG emissions in the EU during 2010. Also, agriculture (11%) and electricity (37%) play a large role in environmental degradation.

Resource-intensive sectors clearly have a large impact on the environment. In response, the EU focuses environmental policies and regulations on improving resource efficiency within those sectors (Rademaekers et al., 2011). Rademaekers et al. (2011) analyze nine resource-intensive sectors, including manufacturing (food and drinks) and construction (cement, steel). Cement, steel, glass and non-ferrous metals are all major input materials used in the construction sector. These sectors drive on the demand in the construction sector (Building Materials, 2014). Rademaekers et al. (2011) find all sectors to have made substantial improvements in the implementation of resource efficiency measures. Reaching goals set by EU and complying with existing regulation are the main reasons why SMEs adopt eco-design practices (Rademaekers et al., 2011). Besides regulatory pressure, Schleich and Gruber (2008) state that resource-intensive sectors have strong internal incentives to improve resource efficiency. When resources are extensively used, investments in resource efficiency become interesting in an economic sense. Cost leadership strategies become more attractive, since cost savings can be realized on large scale (Porter, 1980). Orsato (2006) and Williamson (1991) also state that, in resource-intensive sectors like construction and manufacturing, resource-efficient strategies fits business logic due to financial benefits.

The finding that resource-intensive sectors already made substantial improvements in resource efficiency addresses the need to identify other sectors (and its industries) that may not be that far in adopting eco-design practices, due to for instance less regulatory and public pressure as well as marginal financial benefits. Further elaboration on the influence of sector and industry on SMEs' engagement in eco-design practices is presented in the next chapter, where hypotheses will be formed.

3. Hypotheses

This thesis examines the service sector (and its industries) and its engagement in eco-design practices. In the first section, the service sector will be introduced. In the second section, eco-design processes in industries within the service sector will be analyzed. In the third section, eco-design products and services in industries within the service sector will be analyzed.

3.1 Service sector and eco-design practices

The service sector is identified as less likely to adopt eco-design practices, due to marginal financial incentives (Simpson et al., 2004) and low visibility (Grove et al., 1996). Together with the trend showing an increased use of natural resources (Constantinos et al., 2010), the service sector represents a high potential in decreasing environmental degradation.
Services are mainly intangible and consumed as they are produced (Shostack, 1987; Berry 1980). These characteristics lead to the assumption that services are less threatening to the environment (Grove et al., 1996). Production of physical goods requires materials, processes and outputs that have a direct impact on the environment. As a result, environmental abuses, as well as efforts to behave environmentally friendly, are more visible in, for instance, the manufacturing sector. However, services might not comprise physical elements (intangibility) but they do rely on those elements and natural resources (Grove et al., 1996). To illustrate, the financial services sector extensively uses office space leading to an extreme electricity usage by for instance air-conditioning and computers. The low visibility of environmental efforts in the service industry makes firms less likely to adopt eco-design practices (Grove et al., 1996). Simpson et al. (2004) also find SMEs active in the service sector less likely to make environmental improvements compared to other sectors. The main reason for underperformance is ascribed to the fact that firms active in the service sector do not benefit from a cost leadership strategy (Porter, 1980) in order to realize cost savings. The service sector less extensively uses natural resources compared to other sectors; as a result investments in resource efficiency become less attractive. Based on Grove et al. (1996) and Simpson et al. (2004) the following can be hypothesized:

Hypothesis 1: SMEs active in the service sector are less likely to engage in eco-design practices compared to other sectors

Moreover, the service sector shows an increase in the use of natural resources over the years. Mairet and Decellas (2009) research reliance on natural resources for the French service sector. They find an increase in energy consumption in the service sector by 18% over the period 1995-2006. Constantinos et al. (2010) confirm this increase for the EU as a whole (22% over the period 1990-2005). The service sector is the fastest growing sector compared to other sectors regarding energy consumption. Furthermore, Grove et al. (1996) find service industries to represent a major potential source of environmental preservation. The trend of increased use of natural resources, together with the potential to decrease environmental degradation, further addresses the need to engage in eco-design processes for the service sector.

The service sector comprises very diverse industries. Grove et al. (1996) state that there exist severe differences between industries within the service sector regarding the adoption of eco-design practices. Not all industries are equally capable of contributing to environmental preservation. This research posits several industries within the service sector, based on the NACE classification: Transportation and storage, Accommodation and food service activities, Information and communication, Financial and insurance activities, Real estate activities and Professional, scientific and technical activities. Further elaboration on the NACE classification is provided in the next chapter. The industries of interest discussed in this chapter are as follows: Financial and insurance activities industry (from now on: Financial industry), Transport and storage industry (from now on: Transport industry) and Accommodation and food service activities (from now on: Accommodation industry). In the next section, hypotheses are formed regarding those industries.

3.2 Service sector industries and eco-design processes

As discussed in chapter two, industries characterized by high resource-intensity have financial incentives to invest in eco-design processes (resource efficiency). Based on this assumption, more resource-intensive industries are more likely to invest in eco-design processes. The industries of interest clearly differ in resource-intensity.

3.2.1 Transport industry

The transport industry is identified with the highest resource-intensity compared to other industries within the service sector. The EEA (2013) finds the transport industry to have the largest total final energy consumption within the service sector. Van Veen-Groot and Nijkamp (1999) state that the transport industry is a significant contributor to global environmental degradation, by for instance air pollution. Air pollution in the transport industry is difficult to control, since volumes are steadily increasing and fuel efficiency breakthroughs are not yet in sight (Cole et al., 1997). Transport is the fastest growing industry regarding energy consumption, due to heavily increased volumes in goods and passenger transport (Constantinos et al., 2010). The transport industry appears to face difficulties in reaching environmental targets on resource efficiency set by the EU (European Environment Agency (EEA) Report, 2013). The EEA Report (2013) evaluates industries' performance over the years and checks performance with targets set by the EU. Green and Wegener (1997) state that current trends in transport are not yet sustainable. It will demand fundamental changes in technology, design and operation of transport systems to decrease environmental degradation. However, there are many signs that the transport industry has already started investing in eco-design processes. The Federal Aviation Administration (FFA) introduced the Commercial Aviation Alternative Fuels Initiative (CAAI) back in 2009. This initiative is promoting the development of alternative fuel options as well as creating new flight patterns to reduce current fuel consumption (Price, 2009). The industry is also developing ways to recycle planes and improve the manufacturing processes to be more eco-friendly. Based on the assumption that more resource-intensive industries have stronger financial incentives to engage in eco-design processes, the following can be hypothesized:

Hypothesis 2: SMEs active in transport industry are most likely to engage in eco-design processes compared to other industries within the service sector

3.2.2 Accommodation industry

The accommodation division consists of short-stay accommodations for visitors and other travelers, also defined as the hospitality industry. Besides accommodation, the industry takes food service activities into account, defined as complete meals and drinks fit for immediate consumption (United Nations Statistics Division, 2014). Bohdanowicz (2005) identify the hospitality industry as second greatest polluters and resource consumers within the service sector. This industry exerts a significant impact on global resources (Kirk, 1995; Gossling et al., 2005). Furthermore, a large proportion (50 to 60%) of the waste materials in a hotel can be recycled or reused. Cespedes-Lorente et al. (2003) confirm this high resource intensity by stating that medium-sized hotels consume 507 liters of water per person per day. As the hotel industry is resource intensive, the opportunities for improving eco-design processes are substantial. Stipanuk (2002) and Rosenblum et al. (2000) confirm this finding by stating that hotels extensively use various sources of energy, such as electricity (lightings, air conditioning) and water (laundry and bathrooms). This fact labels the hospitality industry with a high potential for contributing to environmental preservation. Since the hospitality industry is widely seen as part of the service industry, and thus having a less visible impact on the environment, few regulations have emerged regarding environmental issues (Sloan et al. 2009; Knowles et al., 1999; Font, 2002). Due to the lack of regulation, the researchers state that eco-design processes are at a very early stage of its development and many opportunities, especially proactive ones, are not yet integrated. Several other studies show other important factors preventing the adoption of eco-design processes in the hospitality industry, such as institutional factors (lack of support by governments), operational factors (reduction in the quality of products/service offerings) and financial factors (extra costs involved when engaging in eco-design practices) (Chan and Wong, 2006; Kasim, 2007; Tzschentke et al., 2008). The accommodation industry is labeled with a far higher emission intensity compared to the financial industry (Bohdanowicz, 2005; Stipanuk, 2002; Rosenblum et al., 2000). Based on the assumption that more resource-intensive industries have stronger financial incentives to engage in eco-design processes, the following can be hypothesized:

Hypothesis 3: SMEs active in accommodation industry are less likely to engage in eco-design processes compared to transport industry, but more likely to engage in eco-design processes compared to the financial industry

3.2.3. Financial industry

The financial industry is involved with eco-design practices as investors, developers, stakeholders and polluters (Jeucken, 2001). When analyzing eco-design processes, attention is aimed at the industries' role as polluters. Graafland et al. (2003) find firms active in the financial service industry to make less actively use of ISO certification, social reporting, social handbooks and ethics committees compared to other industries in the service sector. These are all other measures of environmental practices (Graafland et al., 2003). Azzone et al. (2000) confirm the finding that the financial sector is relatively slow in applying environmental criteria to investment decisions. Ittner et al. (2003) find environmental performance to be relatively unimportant in the financial services industry compared to other drivers such as customer relations and product and service quality. Furthermore, the European financial industry has not been exposed to environmental liabilities as significantly as the North American sector, leaving eco-design processes in their infancy (Jeucken, 2001). The literature is conclusive about the financial industry to be lax in adopting eco-design processes. In addition, the financial industry less extensively makes use of resources compared to other industries within the service sector. Based on previous research the following can be hypothesized:

Hypothesis 4: SMEs active in financial industry are less likely to engage in eco-design processes compared to other industries within the service sector

3.3 Service sector industries and eco-design products and services

The development of eco-design products and services varies widely within the service sector industries of interest: Accommodation industry, Transport industry and Financial industry.

3.3.1 Accommodation industry

Maloni and Brown (2006) state that the food service industry has many impacts on the environment, for instance water pollution (Fox, 1997) and waste (Boehlje, 1993). Energy use and food purchases have the largest environmental impact. The industry addresses consumers' concerns by offering organic food products, which are characterized by sustainable farming practices and limited use of chemicals (US Department of Agriculture, 2005). The offering of organic food products increases rapidly, but still remains a small segment of the overall food service market (Butler et al., 2004). It seems that a shift towards offering of eco-design products is already visible, although still being in its infancy.

In the accommodation industry, eco-design products and services are slowly beginning to gain ground. A green conference program branded 'Eco-meet' is being developed, having the following key components: eco-service, eco-accommodation and eco-cuisine (Graci and Dodds, 2008). Eco-service enhances disposable-free food services, as well as for instance recycled note pads and bio-degradable pens in meeting rooms. Eco-accommodation focuses at offering products such as recycling bins, bio-degradable soap and water-saving shower heads. Eco-cuisine is focused at menus in hotel restaurants characterized by organic food products. Although only some hotels invest in eco-design products and services, there has been enormous progress so far (Graci and Dodds, 2008). Literature is conclusive about the fact that in the food service industry as well as the accommodation indsutry, eco-design products and services are coming out of its infancy. However, the efforts in becoming more sustainable are still minimal. Though, compared to the other industries of interest, the accommodation industry seems to have gained the most ground regarding eco-design products and services. Therefore, the following can be hypothesized:

Hypothesis 5: SMEs active in accommodation industry are most likely to engage in eco-design practices compared to other industries within the service sector

3.3.3 Transport industry

Previous literature identifies the transport industry with a clear potential to engage in eco-design products and services. Cole et al. (1997) stated that efficiency breakthroughs are not yet in sight. However, the CAAFI is constantly working on a new generation of more efficient airplanes and fuel mixes. In 2009, a new fuel specification is approved using synthetic hydrocarbons, clearly reducing the impact on the environment (Price, 2009). Rail transport is already seen as one the world's greenest sources of transportation. Still, trains are becoming lighter, faster and 100% electric. However, road transport is still lacking the development of eco-design products compared to air and rail transport (Price, 2009). Electric cars are very slowly beginning to gain ground and efficiency improvements like biodiesel and biogas are still minimally used (Price, 2009). Green and Wegener (1997) also state that current trends in transport are not yet sustainable. Few logistics service providers, under which UPS, have started using route-planning software and internet matching systems to reduce GHG emissions and save fuel consumption (Lin and Ho, 2008). Other providers, for instance in Taiwan, fuel their transportation with bio-diesel. Furthermore, logistics and transport providers can legally emit as many CO2-emissions as they want, since there is no strict regulation limiting those firms (Wolf and Seuring, 2010). Logistics are regarded as the 'missing link' for the provision of eco-design products and services to consumers (Wu and Dunn, 1995). It will demand fundamental changes in technology, design and operation of transport systems to decrease environmental degradation (Green and Wegener, 1997). Literature is inconclusive about the transport industry and its efforts to invest in eco-design products and services. Although some improvements are beginning to gain ground, most firms do not yet engage in eco-design products. Based on previous research the following can be hypothesized:

Hypothesis 6: SMEs active in the transport industry are less likely to engage in eco-design products and services compared to the accommodation industry, but more likely to engage in eco-design products and services compared to the financial industry

3.3.2 Financial industry

The financial industry is involved with eco-design practices as investors, developers, stakeholders and polluters (Jeucken, 2001). Firms provide businesses with capital for investment, develop financial products that can strengthen sustainable development, prevent businesses from running environmental risks and act as polluters with their own operations. The financial industry plays a large role in tackling environmental degradation (Jeucken, 2001). Firms within the industry created specialized ‘green’ credit products, mortgages and insurance policies as well as ‘green’ funds, which all invest in environmentally friendly firms (Jeucken, 2001; Schaltegger and Figge, 2001). However, investment managers are worried about financial performance regarding those ‘green’ funds (Birkensleigh et al., 2013). Also, only a small number of insurance companies in Europe are reporting on their environmental performance (Birkensleigh et al., 2013). The government stimulates ‘green funds’ by adopting a law (in the Netherlands) which states that firms do not have to pay capital income tax for green credit funds if at least 70% of the money is invested in green projects (van Bellegem, 2001).

However, the offering of products and services in the field of sustainable banking business is still minimal (Weber, 2005). In Weber’s (2005) research, only 20 out of 119 banks and financial institutions integrated sustainability into their business strategies and practices. Peeters (2003) confirms that the financing of sustainable development is at this moment highly insufficient. He states that there is a critical need for a more integrated and sustainable financial system. Although the EU leads the world in voluntary public environmental and social reporting (Birkensleigh et al., 2013), the offering of eco-design products and services remains a small percentage of the high potential identified by Jeucken (2001).

Based on previous research the following can be hypothesized:

Hypothesis 7: SMEs active in the financial industry are least likely to engage in eco-design products and services compared to other industries within the service sector

4. Data and Methodology

An introduction into the data is presented in the first section. The second section describes the dependent variables used throughout this research, followed by the independent variables and control variables in section three and four. Finally, in the fifth section the methodology is elucidated.

4.1 Dataset

This research uses data from the Flash Eurobarometer survey no. 342 on “SMEs towards resource efficiency and green markets”. This telephonic survey was carried out between the 24th of January and the 10th of February 2012. The survey has been requested by the European Commission, intending to raise SMEs’ awareness of environmental issues. The database contains information on 10,855 firms in the 27 Member States of the EU as well as 2,312 firms in other parts of Europe and the USA. The sample for this research contains a total of 11,986 firms which are defined as SMEs. Representatives of targeted SMEs were asked to answer 32 questions regarding resource efficiency, green markets and green jobs. The survey covers SMEs employing at least 1 person in several sectors: Manufacturing, Retail, Services and Industry. The sectors are further specified, based on NACE coding. The samples of firms are selected from an international business database.

4.2 Dependent variables

This research uses two main dependent variables capturing eco-design practices. The first dependent variable is labeled “eco-design products”. This variable is constructed by analyzing the question: “How much do green products or services represent in your turnover?” The second dependent variable is labeled “eco-design processes”. This variable is constructed by analyzing the question: “Over the past two years, how much have you invested on average per year to be more resource-efficient?” The first subsection describes the construction of both dependent variables. The second subsection discusses the level of compliance taken into account in order to construct the dependent variables. The full question survey is provided in Appendix 1 for all sectors and Appendix 2 for the service sector.

Eco-design products

Eco-design products are closely related to green products and play a large role in improving eco-efficiency (Tukker et al., 2001; Bauman et al. 2002). This variable captures the extent to which SMEs offers eco-design products or services in their portfolio. SMEs are asked whether they offer green products or services in their portfolio. If so, SMEs indicate which percentage of their turn-over represents green products and services. Throughout this research, the following answer options are taken into account: does not offer eco-design products and services (0%), minor (1-10%), substantial (11-50%) and large (51% or more) involvement. Thus, the variable "eco-design products" is a categorical variable. The answer option "does not offer eco-design products and services (0%)" will be used as reference category.

Eco-design processes

Resource efficiency is the key indicator for eco-design processes (Section 2.2). This variable captures the extent to which SMEs engage in eco-design processes. Firms can undertake several actions to be more resource efficient, such as saving water, saving energy, using renewable energy, saving materials, minimizing waste, selling scrap material, recycling and more. SMEs indicate which percentage of their turn-over is invested in eco-design processes. Throughout this research, the following answer options are taken into account: does not engage in eco-design processes (0%), minor (1-10%), substantial (11-50%) and large (51% or more) investment. Thus, the variable "eco-design processes" is a categorical variable. The answer option "does not engage in eco-design processes (0%)" will be used as reference category.

Criteria for sample selection: Compliance level

Eco-design practices are part of proactive environmental practices (Jeswiet and Hauschild, 2005; Tukker et al., 2001; Sarkis et al., 2010). It is important to divide the sample by only taking into account proactive eco-design practices, which are defined as 'going beyond compliance' (Sharma, 2000; Andersson and Bateman, 2000). In order to observe eco-design practices, this is a crucial step. The dependent variables only take into account SMEs pursuing proactive environmental practices.

In the first question of the Flash Eurobarometer 342, SMEs are asked to which extent they comply with environmental legislation. It is important to know whether firms comply with existing regulation and doing more effort to address environmental concerns. The first answer option 'complying with environmental legislation but does not wish to go beyond these requirements' defines reactive environmental practices (Sarkis et al., 2010; Schot and Fischer, 1993). The last answer option 'having difficulties in complying with environmental legislation' lacks the use of proactive environmental practices for firms. SMEs answering this question with other possible answer options are taken into account for the construction of the dependent variables. Other possible answer options are: complying with environmental legislation and contemplating doing more, going beyond the requirements of the environmental legislation but it is not one of its priorities, going beyond compliance and environmental concerns being among the firm's priority objectives.

4.3 Independent variables

Previous literature indicates that resource-intensive industries show a higher adoption rate compared to industries not being that resource-intensive (Rademaekers et al., 2011; Schleich and Gruber, 2008; Orsato, 2006; Williamson, 1991). Sectors and its industries seem to differ regarding adoption in eco-design practices. This research uses NACE coding to identify in which sectors and industries firms operate. NACE is a European industry standard classification. The independent variables used throughout this research relate to the service sector and its industries.

Service sector

To examine the first hypothesis, a dummy variable is created taking the value 1 when a firm is active in the service sector and 0 otherwise. This research' first step is to examine whether the service sector is less likely to engage in eco-design practices compared to other sectors.

Industries within the service sector

The second step focuses on several industries within the service sector. In subsequent analyses, the sample will only exist of firms operating in the service sector. A categorical variable is created, taking into account each industry within the service sector. Dummy variables are created for each industry of interest. The "Accommodation and food services activities" industry will be used as reference category. The industries of interest are as follows: "Financial and insurance activities", "Transport and Storage" and "Accommodation and food service activities". Table 2 provides an overview of the service sector and its industries, including statistics on the number of SMEs in the sample. Furthermore, almost 82% of the SMEs operate in the EU. Over 45% of SMEs employ up to 9 people, while relatively larger SMEs (49-250 employees) represent 20% of the sample.

NACE Category K consists of Financial and Insurance activities. This section includes financial service activities (obtaining and redistributing funds) as well as insurance, reinsurance, and pension funding (United Nations Statistics Division, 2014).

NACE category I consists of Accommodation and Food service activities. This section includes short-stay accommodation for visitors and other travelers, as well as the provision of complete meals and drinks fit for immediate consumption. Short-stay accommodation mainly consists of hotels, camping grounds and student residences and is widely interpreted as the hospitality industry (United Nations Statistics Division, 2014).

NACE category H consists of Transportation and Storage. This section includes passenger and freight transport by all possible modes of transport. Associated activities, such as terminal and parking facilities at an airport, are also taken into account as well as postal and courier activities (United Nations Statistics Division, 2014).

Service sector					
H (NACE)	**I (NACE)**	**J (NACE)**	**K (NACE)**	**L (NACE)**	**M (NACE)**
Transportation and Storage	Accommodation and food service activities	Information and Communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities
634 SMEs	565 SMEs	363 SMEs	210 SMEs	378 SMEs	978 SMEs
20.27%	18.06 %	11.60%	6.71%	12.08%	31.27%

Table 2: Service sector (NACE Classification)

4.4 Control variables

Besides dependent and independent variables, control variables are added to the models to control for possible factors that might influence the relationship between eco-design practices and the service sector or individual industries. This research will estimate two models for each dependent variable: eco-design products and services and eco-design processes. The expectation of a clear link between both variables emphasizes the need to take the other variable into account as control (in the model where eco-design products and services (or eco-design processes) is not the dependent variable). The answer options “0% of annual turn-over” will be used as reference category. In addition, control variables are drawn from previous literature and are as follows: country characteristics, the integration of EMS, firm size and firm age. Exact definitions of the control variables can be found in Appendix 1 for all sectors and Appendix 2 for the service sector.

Country characteristics

Delmas and Toffel (2004) finds strong regulatory, normative and cognitive differences between countries which affect the costs and potential benefits of adopting eco-design practices. Buysse and Verbeke (2003) confirm her finding by stating that smaller open economies face different configuration of environmental stakeholders compared to larger economies. Liefferink and Andersen (1998) find large differences in eco-design strategies between countries within the EU. The literature is conclusive about the fact that countries show large differences regarding the adoption of eco-design practices. To control for heterogeneity between countries regarding the adoption of eco-design practices, country dummies are included in the models.

EMS

Environmental management systems (EMS) can be implemented by firms in order to achieve sustainable development. EMS is the documentation of environmental performance, primarily focused on design, pollution control, waste minimization and setting goals (Melnyk et al., 2013). Gonzaléz et al. (2008) find firms that implemented EMS to have a higher probability of developing eco-design practices. Hoogendoorn et al. (2014) also take into account the implementation of EMS as a control variable. Therefore, EMS is taken into account as control variable, since the implementation of EMS might influence the relationship between industries and the adoption of eco-design practices. A dummy variable is created taking the value 1 if SMEs implemented EMS and 0 otherwise.

Firm size

Darnall et al. (2010) find eco-design practices to be positively associated with firm size. Hoogendoorn et al. (2014) find larger SMEs to show a higher engagement in eco-design processes. Smaller firms are less likely to adopt eco-design practices compared to larger firms, for internal (financial) reasons and regulatory pressure by stakeholders (Darnall et al., 2010). Aragon-Corréa et al. (2008) also find firm size to be a relevant condition for developing eco-design practices. Firm size can be measured in many ways, such as market value (based on turn-over) and the number of employees. This research will measure firm size by the number of employees. This variable consists of micro firms (1-9 employees), small firms (10-49 employees) and medium sized firms (50-249 employees). This categorical variable with three categories will allow controlling for heterogeneity between firms regarding size. Micro firms (1-9) employees will be used as reference category.

Firm age

Firm age is positively related to eco-design processes. Eltayeb and Zailani (2009) find that older firms are more likely to reduce environmental impact by investments in eco-design processes. In addition, Neubaum et al. (2004) suggest that young firms can be negatively influenced by their need to survive regarding ethical behavior. It is more important to survive than to invest in eco-design practices for many young firms. This categorical variable with four categories will allow controlling for heterogeneity between firms regarding age. Firm age distinguishes between firms that exist for 1-5 years, 6-9 years, 10-19 years and over 19 years. Firms that exist for 1-5 years will be used as reference category.

4.5 Methodology

In order to test the relationship between individual industries and the extent to which those industries engage in eco-design practices, a model that suits this research is needed. This research uses two dependent variables. Therefore, four tables containing several models will be constructed to analyze the service sectors and its industries. The model estimating eco-design products, as well as eco-design processes, provides four different answer options, ranging from does not engage (0% of turn-over) to minor (1-10%), substantial (11-50%) and large (51% or more) investment. This model uses ordered logit regressions in order to test the relationship mentioned in the hypotheses. Ordered logit regression models are used when the dependent variable is ordered and categorical, which is the case concerning eco-design products and eco-design processes.

The following expression is used for ordered logit regression models:

$$P(y = j \mid x_1, x_2) = \frac{\exp(\tau_j - \beta_1 x_1 - \beta_2 x_2)}{1 + \exp(\tau_j - \beta_1 x_1 - \beta_2 x_2)} - \frac{\exp(\tau_{j-1} - \beta_1 x_1 - \beta_2 x_2)}{1 + \exp(\tau_{j-1} - \beta_1 x_1 - \beta_2 x_2)}$$

Basically, P stands for the probability. Y equals the four different answer possibilities. X_1 and X_2 represent the independent variables. The independent variables are the service sector and its industries. If the coefficient of an independent variable turns out to be negative and significant, is it is possible to interpret the sign to make an assumption about the marginal effect of the independent variable.

5. Results

In this section, the results of the empirical models created to analyze the hypotheses are discussed. Ordered logit models are constructed to examine the effect of the service sector and its industries on the probability of engagement in eco-design practices. The results are displayed in four tables. Table 3 (Table 4) presents the results of SMEs' engagement in eco-design processes (products and services) for the service sector compared to other sectors. Table 5 (Table 6) presents the results of SMEs' engagement in eco-design processes (products and services) for the individual industries within the service sector. Each table includes country dummies to control for heterogeneity regarding the adoption of eco-design practices between countries. Furthermore, each table consists of two model specifications. Model 1 is the baseline model and only includes control variables. Model 2 is the full model and includes independent variables of interest as well as control variables.

Model 2 of Table 3 shows the effect of the service sector on SMEs' engagement in eco-design processes. SMEs active in the service sector have a lower probability of engagement in eco-design processes compared to other sectors. This finding is consistent with hypothesis 1: *"SMEs active in the service sector are less likely to engage in eco-design practices compared to other sectors*".
Model 1 of Table 3 shows the effect of control variables on SMEs' engagement in eco-design processes. First, if SMEs' engage in eco-design products and services, compared to no engagement, they have a higher probability of engaging in eco-design processes as well. The more SMEs engage in eco-design products and services, the higher the probability of engaging in eco-design processes. Second, SMEs employing 10-49 or 50-249 people have a higher probability of engaging in eco-design processes compared to SMEs employing 1-9 people. Third, SMEs with a firm age of over 19 years have a higher probability of engaging in eco-design processes compared to SMEs with a firm age of 1-5 years. This result is significant at a 10% level. Fourth, SMEs implementing EMS have a higher probability of engagement in eco-design processes. The findings for control variables remain the same in model 2.

Model 2 of Table 4 shows the effect of the service sector on SMEs' engagement in eco-design products and services. SMEs active in the service sector have a lower probability of engagement in eco-design products and services compared to other sectors. This finding is

consistent with hypothesis 1.
Model 1 of Table 4 shows the effect of control variables on SMEs' engagement in eco-design products and services. First, if SMEs engage in eco-design processes, compared to no engagement, they have a higher probability of engagement in eco-design products and services as well. The more SMEs engage in eco-design processes, the higher the probability of engaging in eco-design products and services. Second, firm size measured by the number of employees is not significant. Third, firm age is not significant. Fourth, SMEs implementing EMS have a higher probability of engagement in eco-design processes. The findings for control variables remain the same in model 2.

In subsequent analyses, the sample will only exist of firms operating in the service sector. Therefore, the results presented below are only applicable to SMEs in the service sector.

Model 2 of Table 5 shows the effect of the individual industries within the service sector on SMEs' engagement in eco-design processes. SMEs active in industry 'Professional, scientific and technical activities' have a lower probability of engagement in eco-design processes compared to the Accommodation industry. Other service sector industry dummies turn out to be insignificant, meaning that the Transport industry and the Financial industry do not statistically differ from the Accommodation industry regarding engagement in eco-design processes. Therefore, this thesis cannot draw conclusions on the engagement in eco-design processes for the industries of interest as hypothesized in hypothesis 2, 3 and 4. However, the engagement in eco-design products and services for the industries of interest will be discussed in the next subsection.
Model 1 of Table 5 shows the effect of control variables on SMEs' engagement in eco-design processes. First, if SMEs' engage in eco-design products and services, compared to no engagement, they have a higher probability of engagement in eco-design processes. Second, SMEs employing 10-49 or 50-249 people have a higher probability of engagement in eco-design processes compared to SMEs employing 1-9 people. Third, firm age is not significant. Fourth, SMEs implementing EMS have a higher probability of engagement in eco-design processes. The findings for control variables remain the same in model 2.

Model 2 of Table 6 shows the effect of the individual industries within the service sector on SMEs' engagement in eco-design products and services. SMEs active in the Transport industry as well as the Financial industry have a lower probability of engagement in eco-design products and services compared to the Accommodation industry. It turns out that the Accommodation industry is more likely to engage in eco-design products and services compared to the Transport and Financial industries. This finding is consistent with hypothesis 5. Furthermore, SMEs active in the Transport industry have a higher probability of engagement in eco-design products and services compared to the Financial industry. This finding is consistent with hypothesis 6. SMEs active in the Financial industry have the lowest probability of engagement in eco-design products and services compared to other industries within the service sector. This finding is consistent with hypothesis 7, which states that SMEs active in the Financial industry are least likely to engage in eco-design products and services. Other service sector industry dummies turn out to be insignificant, meaning that those industries do not significantly differ from the Accommodation industry regarding engagement in eco-design products and services.

Model 1 of Table 6 shows the effect of control variables on SMEs' engagement in eco-design products and services. First, if SMEs' engage in eco-design processes, compared to no engagement, they have a higher probability of engagement in eco-design products and services. Second, firm size measured by the number of employees is not significant. Third, the effect of firm age on eco-design products and services is not significant. Fourth, SMEs implementing EMS have a higher probability of engagement in eco-design products and services. The findings for control variables remain the same in model 2.

6. Conclusion and Discussion

This thesis examines the influence of industries within the service sector on SMEs' engagement in eco-design practices. Two types of eco-design practices are distinguished: eco-design products and services and eco-design processes. The results indicate that SMEs active in the service sector are less likely to engage in eco-design practices. Consistent with the expectations, this result corresponds with earlier studies showing that the service sector has marginal financial incentives (Simpson et al., 2004) and a low visibility (Grove et al., 1996).

Contrary to the expectations, the results show insignificant outcomes for the industries of interest within the service sector regarding eco-design processes. The Transport industry, the Accommodation industry as well as the Financial industry are equal likely to engage in eco-design processes. Hypotheses based on resource intensity do not hold for individual industries within the service sector. The finding that resource-intensive sectors are more likely to engage in eco-design processes (Rademaekers et al., 2011; Schleich and Gruber, 2008) does not seem to be translatable to industries within the service sector. It might be that differences in resource intensity are smaller for those industries. Resource-intensive sectors like manufacturing show larger differences between industries regarding resource intensity in relation to other sectors (Rademaekers et al., 2011).

Consistent to the expectations, the results show that SMEs active in the Accommodation industry are most likely to engage in eco-design products and services. This result corresponds with earlier studies showing that this industry has gained the most ground regarding eco-design products and services due to the offering of organic food products (Butler et al., 2004) and eco-products in hotels (Graci and Dodds, 2008). The Transport industry is more likely to engage in eco-design products and services compared to the other industries. The Transport industry is very competitive, which makes it attractive for firms to distinguish from competitors by introducing more efficient transport modes. This finding is supported by Price (2009) stating that fuel mixes are being developed in order to become more efficient. Also, the Transport industry is highly visible compared to other industries within the service sector regarding sustainability issues (Price, 2009). Consistent to the expectations, this thesis finds support for the argument that the Financial industry is least likely to engage in eco-design products and services compared to the other industries. This result corresponds with earlier research stating that the Financial industry is investing in ‘green’ credit products and funds on a very small scale (Jeucken, 2001; Schaltegger and Figge, 2001).

This thesis intended to examine the influence of industries within the service sector on SMEs’ engagement in eco-design practices. Since SMEs in the service sector are identified as less likely to engage in eco-design practices, this sector has to be addressed properly by policy makers and governments. First, industries do not seem to differ regarding the adoption of eco-design processes. Therefore, policies and regulations regarding resource efficiency should be aimed at the service sector as a whole. Second, The Financial industry turns out to be least likely to engage in eco-design products and services. This finding under scribes the need to develop strict environmental regulation focused on a limited maximum emissions intensity (Jeucken, 2001) and further subsidization of ‘green’ credit products and funds (Schaltegger and Figge, 2001). The uncertain financial performance of ‘green’ credit products and funds, as identified by Birkensleigh et al. (2013), further addresses the need for subsidization. Moreover, the high potential of the Financial industry to tackle environmental degradation, as identified by Jeucken (2001), calls for an industry-specific approach to stimulate the development of eco-design products and services. Policy makers could stimulate environmental transparency throughout the Financial industry in order to raise competitive sustainable behavior. Further research is needed to examine why the Financial industry is not yet investing in developing eco-design products and services.

Since this thesis focuses on the service sector and its industries, it is hard to draw conclusions on individual firms. The NACE classification offers a more detailed subdivision of industries. For instance, the Financial industry consists of very diverse firms: banks, insurance firms and pension funds. Further research could focus on the subdivision within the Financial industry, in order to provide policy makers and governments with a more detailed recommendation on which firms are underperforming regarding eco-design products and services. Moreover, this thesis only analyzed European firms. The Financial industry in North America has been more exposed to environmental legislation compared to Europe (Jeucken, 2001). This finding addresses the need to compare the success of environmental legislation in order for firms to adopt eco-design. Policy makers and governments can find the optimal degree of environmental legislation when analyzing more environmental-friendly developed countries or continents, such as North America (Jeucken, 2001). To conclude, this thesis provides several contributions to existing literature. This is the first research focusing on SMEs within the service sector in a cross-country setting. The findings under scribed the importance of the service sector to decrease environmental degradation. By analyzing firms throughout Europe, recommendations for policies and regulations are interesting for the EU as well. Furthermore, domestic regulation has to be approved by the EU and strengthens the need for focused cross-country regulation. Second, SMEs active in the Financial industry are underperforming regarding the adoption of eco-design products and services compared to other industries within the service sector. This finding addresses the need to stimulate SMEs active in the Financial industry into engaging in eco-design products and services.

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Table 3: Ordered logit estimation results with eco-design processes as dependent variable. Full sample

	(1) Baseline model	(2) Full model
Service sector dummy		-0.224** (0.08)
Control variables Eco-design products/services (0% of annual turnover) (ref.)		
1-10% of annual turnover	0.873*** (0.10)	0.864*** (0.10)
11-50% of annual turnover	1.128*** (0.14)	1.122*** (0.14)
>50% of annual turnover	1.472*** (0.13)	1.445*** (0.13)
Firm size: 0-9 employees (ref.)		
10-49 employees	0.361*** (0.08)	0.366*** (0.08)
50-249 employees	0.381*** (0.09)	0.389*** (0.09)
Firm age: 1-5 years (ref.)		
6-9 years	0.092 (0.13)	0.096 (0.13)
10-19 years	0.179 (0.11)	0.180 (0.11)
19+ years	0.232* (0.11)	0.216* (0.11)
Dummy Environmental Management System	1.357*** (0.08)	1.343*** (0.09)
Country Dummies	YES	YES
Observations	5630	5630
Pseudo R^2	0.1414	0.1425

a) Standard errors in parentheses
b) Ordered dependent variable *eco-design processes*: 1) 0% of annual turnover; 2) 1%-10% of annual turnover; 3) 11%-50% of annual turnover; 4) >50% of annual turnover.
c) Other sectors include Manufacturing, Retail and Industry
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Ordered logit estimation results with eco-design products and services as dependent variable. Full sample

	(1) Baseline model	(2) Full model
Service sector dummy		-0.378***
		(0.07)
Control variables		
Eco-design processes (0% of annual turnover) (ref.)		
1-10% of annual turnover	2.440***	2.432***
	(0.08)	(0.08)
11-50% of annual turnover	3.061***	3.062***
	(0.13)	(0.13)
>50% of annual turnover	3.883***	3.847***
	(0.30)	(0.30)
Firm size: 0-9 employees (ref.)		
10-49 employees	-0.022	-0.011
	(0.07)	(0.07)
50-249 employees	0.069	0.094
	(0.08)	(0.08)
Firm age: 1-5 years (ref.)		
6-9 years	-0.042	-0.037
	(0.12)	(0.12)
10-19 years	-0.004	-0.004
	(0.9)	(0.9)
19+ years	-0.085	-0.113
	(0.9)	(0.9)
Dummy Environmental Management System	0.336***	0.317***
	(0.06)	(0.06)
Country Dummies	YES	YES
Observations	9911	9911
Pseudo R^2	0.1541	0.1564

Standard errors in parentheses

a) Standard errors in parentheses

b) Ordered dependent variable *eco-design products and services*: 1) 0% of annual turnover; 2) 1%-10% of annual turnover; 3) 11%-50% of annual turnover; 4) >50% of annual turnover.

c) Other sectors include Manufacturing, Retail and Industry

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Ordered logit estimation results with eco-design processes as dependent variable. Service sector sample, other sectors excluded.

	(1) Baseline model	(2) Full model
Accommodation industry dummy (ref.)		
Transportation industry dummy		-0.243
		(0.22)
Financial industry dummy		-0.271
		(0.32)
Information industry dummy		-0.276
		(0.26)
Real Estate industry dummy		-0.069
		(0.26)
Professional industry dummy		-0.436*
		(0.20)
Control variables		
Eco-design products and services (0% of annual turnover) (ref.)		
1-10% of annual turnover	0.875***	0.844***
	(0.22)	(0.22)
11-50% of annual turnover	1.459***	1.466***
	(0.28)	(0.28)
>50% of annual turnover	1.774***	1.801***
	(0.32)	(0.32)
Firm size: 0-9 employees (ref.)		
10-49 employees	0.287	0.258
	(0.15)	(0.15)
50-249 employees	0.466**	0.433*
	(0.19)	(0.19)
Firm age: 1-5 years (ref.)		
6-9 years	0.056	0.050
	(0.23)	(0.23)
10-19 years	0.213	0.206
	(0.20)	(0.20)
19+ years	0.230	0.215
	(0.9)	(0.9)
Dummy Environmental Management System	1.627***	1.619***
	(0.18)	(0.18)
Country Dummies	YES	YES

Observations	1435	1435
Pseudo R^2	0.1794	0.1819

a) Standard errors in parentheses

b) Ordered dependent variable *eco-design processes*: 1) 0% of annual turnover; 2) 1%-10% of annual turnover; 3) 11%-50% of annual turnover; 4) >50% of annual turnover.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Ordered logit estimation results with eco-design products and services as dependent variable. Service sector sample, other sectors excluded.

	(1) Baseline model	(2) Full model
Accommodation industry dummy (ref.)		
Transportation industry dummy		-0.628**
		(0.21)
Financial industry dummy		-0.946**
		(0.33)
Information industry dummy		-0.167
		(0.23)
Real Estate industry dummy		-0.250
		(0.24)
Professional industry dummy		-0.100
		(0.18)
Control variables		
Eco-design processes (0% of annual turnover) (ref.)		
1-10% of annual turnover	2.691***	2.679***
	(0.18)	(0.18)
11-50% of annual turnover	3.545***	3.537***
	(0.28)	(0.29)
>50% of annual turnover	3.517***	3.576***
	(0.81)	(0.79)
Firm size: 0-9 employees (ref.)		
10-49 employees	0.239	0.263
	(0.15)	(0.15)
50-249 employees	0.196	0.300
	(0.17)	(0.17)
Firm age: 1-5 years (ref.)		
6-9 years	-0.068	-0.102
	(0.24)	(0.24)
10-19 years	-0.027	-0.030
	(0.20)	(0.20)
19+ years	-0.154	-0.073
	(0.20)	(0.20)
Dummy Environmental Management System	0.410**	0.421**
	(0.14)	(0.14)

Country Dummies	YES	YES
Observations	2615	2615
Pseudo R^2	0.1904	0.1963

a) Standard errors in parentheses

b) Ordered dependent variable *eco-design products and services:* 1) 0% of annual turnover; 2) 1%-10% of annual turnover; 3) 11%-50% of annual turnover; 4) >50% of annual turnover.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendices

Appendix 1: Definitions and descriptives of dependent variables and control variables for all sectors. Numbers represent % of SMEs belonging to a specific category.

Variable	Categories / Answer options	%
Dependent variables		
Eco-design processes		
Over the past two years, how much have you invested on average per year to be more resource efficient?	Does not engage in eco-design processes (ref.)	14
	1-10% of annual turn-over	78
	11-50% of annual turn-over	7
	More than 50% of annual turn-over	1
Eco-design products and services		
How much do green products or services represent in your turn-over (latest available fiscal year)?	Does not offer eco-design products and services (ref.)	82
	1-10% of annual turn-over	9
	11-50% of annual turn-over	4
	More than 50% of annual turn-over	5
Control variables		
EMS		
Does your company use one or more of these environmental management systems?	No	65
	Yes	35
Firm size		
Measured by number of employees	0-9 employees (ref.)	45
	10-49 employees	34
	50-249 employees	21
Firm age		
Measured by number of years	1-5 years	14
	6-9 years	12
	10-19 years	31
	More than 19 years	43

Source: Flash Eurobarometer survey on “SMEs, resource efficiency, and green markets” (no. 342), 2012.

Appendix 2: Definitions and descriptives of dependent variables and control variables for the service sector. Numbers represent % of SMEs belonging to a specific category.

Variable	Answer options	%
Dependent variables		
Eco-design processes		
Over the past two years, how much have you invested on average per year to be more resource efficient?	Does not engage in eco-design processes (ref.)	19
	1-10% of annual turn-over	74
	11-50% of annual turn-over	6
	More than 50% of annual turn-over	1
Eco-design products and services		
How much do green products or services represent in your turn-over (latest available fiscal year)?	Does not offer eco-design products and services (ref.)	86
	1-10% of annual turn-over	7
	11-50% of annual turn-over	4
	More than 50% of annual turn-over	3
Control variables		
EMS		
Does your company use one or more of these environmental management systems?	No	69
	Yes	31
Firm size		
Measured by number of employees	0-9 employees (ref.)	45
	10-49 employees	35
	50-249 employees	20
Firm age		
Measured by number of years	1-5 years	17
	6-9 years	14
	10-19 years	32
	More than 19 years	37

Source: Flash Eurobarometer survey on “SMEs, resource efficiency, and green markets” (no. 342), 2012.