SCHOOL OF ECONOMICS AND MANAGEMENT

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Product Life Extension: A Quantitative Analysis of Economic Value Retention in a Circular Economy Business Model

By Elsa Nordström
el0505no-s@student.lu.se

This study investigates the creation of economic value within the Product Life Extension (PLE) business model, focusing on how specific product categories and characteristics impact the retention of value and revenue streams of PLE firms. Using Godsinlösen AB as a case study, the research quantitatively examines sales data to explore the retention of product value and consumer preferences for reused goods by examining the relationship between original price and resell price as well as stock turnover. Key findings reveal that themes such as durability, quality, and functionality, along with market characteristics, may influence value retention. Products such as IT & electronics, and furniture & interior items show varying degrees of value retention and stock turnover, with electronics seemingly experiencing rapid depreciation likely due to market dynamics and consumer preferences. In contrast, furniture & interior items seem to retain value better and sell faster, probably due to slower market changes and more durable designs. Given that different product categories experience varying levels of economic value retention, it is important for firms within this model to target products with higher embedded value or potential for value addition to achieve profitability and foster sustainable growth in the circular economy. To further explore this topic, additional research should be conducted on other product categories and specific types of products in detail, preferably over time for additional firms, to obtain more generalizable results.

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List of Abbreviations

B2C	Business-to-Customer
B2B	Business-to-Business
CE	Circular Economy
CBM	Circular Business Model
EU	European Union
GIAB	Godsinlösen AB
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PLE	Product Life Extension
SBM	Sustainable Business Model Framework
SMEs	Small and Medium-Sized Enterprises
TPB	Theory of Planned Behaviour
WTP	Willingness to Pay

1. Introduction

Numerous studies focus on the reasons behind the consumer's choice to purchase reused and refurbished goods, from financial considerations to environmental awareness. Although buying reused goods is an individual effort to reduce the consumption of new goods and materials and contribute to a more resilient future, the evolving world requires collective responsibility beyond individual actions for a sustainable transition.

The transition towards a circular economy is important in a broader perspective, where actions are needed to create a difference for our environment and the resource use of today. To speed up the systematic transition in Europe, the European Union has developed several initiatives for circular transformation, such as the Circular Economy Action Plan, which is under the Green Deal and will function as an overall plan to ensure that resources are used in a more circular way today and in the future. It is therefore important that everyone takes their responsibilities, not least companies and retailers, who primarily feed the linear economy where products are reused to a low extent.

Companies can reduce their environmental impact and take action by adopting circular business models (CBM), aiming to minimise natural resource extraction and depletion while maximising the useful life of the product and material. There are several ways to adopt a CBM, depending on the firm's position in the value chain and its business concept. This study will focus on the Product Life Extension (PLE) business model, which involves activities such as product design for longevity, direct reuse, maintenance and repair, and refurbishment and remanufacturing. Specifically, this study will concentrate on the latter three activities, focusing on third-party firms, often referred to as Gap-exploiters, engaged in circular loops to extend the lifespan of manufactured products and reduce the inflow of new products and materials into the market (OECD, 2018).

But the business model not only makes a demand on the firm, it also places a demand on the characteristics and design of the products, subsequently affecting the reusability and the retention of economic value. Not all products can be reused in a way that would be desirable because some products are designed for a linear system where their economic value and quality are not enough to be reused. Therefore, not all products are profitable for a PLE firm to refurbish, repair, reuse or resell, at least not with a focus on economic value retention. Employing a PLE business model therefore requires the firm to optimise what products are profitable in the specific case, depending on both firm-specific factors, such as handling cost and reselling channels, but also depending on product characteristics, such as product category, condition, and original price. The influence of consumer behaviour and preferences is also always present, defining the market demand and working as an external force on retention of value through their willingness to pay and their customer needs.

However, for a successful shift towards a more circular economy, it must be financially feasible, as firms require profits and optimised product management to effectively reduce

emissions and minimise environmental impacts in the long run. To further explore this topic, this study will be conducted through an in-depth case study of a Swedish company operating with a PLE business model. The study will explore the relationship between different categories of products and their retention of value in reuse, as well as other factors that affect the value of a product and the willingness of customers to pay, such as condition, resell channel and original price. Through a quantitative analysis, the retention value, and hence the profitability as well as the stock turnover as a proxy for consumer demand, will be analysed and discussed guided by previous research and theoretical framework in the field of circular economy and product life extension.

1.1 Purpose and Contribution

The objective of this study is to explore and analyse the practical implications of the Product Life Extension (PLE) business model and the factors influencing the retention of value and the stock-turnover for various products. Through the literature review, a gap was identified, indicating a lack of real-life firm experiences and sales data analysis for specific types of circular business models (CBMs). Additionally, the study aims to analyse consumer preferences by examining stock turnover of different product characteristics both by group and by original retailer. Using internal sales data from the case company Godsinlösen AB, this study seeks to understand the optimal reuse-deal in terms of economic value while controlling for variables such as product category, condition, original price, cost of handling, and resell channel, among others.

This research will contribute to the expanding literature on the circular economy by offering a comprehensive real-life example of how various categories and characteristics of products can affect the operation, applicability, and profitability of the PLE business model. Using an extensive quantitative methodology, including descriptive statistics and linear regressions of sales data, the study aims to deepen the understanding of large-scale reuse and the factors influencing the PLE model in practical scenarios. The research questions address both internal and external perspectives, emphasising the relationship between firm profitability and customer willingness to pay, as well as the impact of condition and other related factors.

In a broader context, gaining deeper insights into the transition toward a more circular use of resources is crucial for redirecting policies and legislation towards areas requiring improvement. Understanding product reusability is essential to develop frameworks and goals at both the national and international levels to address issues in the value chain effectively. Furthermore, specific firms engaged in PLE business models benefit from understanding how different product characteristics affect profitability, enabling them to adapt and adjust their strategies and operations accordingly based on the specific product categories within their value chain and operational flow.

1.2 Research Questions

This study seeks to explore the topic while analyzing and discussing the following research questions:

1. How do specific product categories and characteristics within the Product Life Extension (PLE) business model influence the retention of economic value, thereby affecting the revenue streams of PLE firms?

2. How do the characteristics of different products impact the duration of stock turnover within the PLE model?

1.3 Delimitations

This study will be conducted as an exploratory case study, investigating the implications for a Swedish company within the Swedish market and the regulatory landscape of the European Union.

The study will focus on the retention of economic value in products and reusability from a firm perspective. It will not delve deeply into the function or reusability of the product from a consumer perspective. Although the environmental benefits of participating in circular economy initiatives are inherent in using fewer resources, they will not be part of the quantitative analyses in this case.

The focus of the PLE (Product Life Extension) business model in this case will be on third-party firms rather than the manufacturers or producers of the products. These firms aim to prolong the life of products through activities such as reselling, repairing, and refurbishing, commonly referred to as "gap exploiters," with a focus on the business-to-consumer (B2C) relationship.

Although the purchase of second-hand goods is a growing trend, this study will not focus on traditional organizations in second-hand markets where used goods are typically sold in their current condition, generally donated by consumers. Companies selling reused and refurbished goods engage in a more complex process and often source their products from retailers, operating within a more intricate value chain. Reused and refurbished goods typically undergo a thorough inspection, repair, and sometimes upgrade or replacement of components to ensure they meet certain standards of quality and functionality. Consequently, these types of companies are dependent on revenue generation.

2. Background

The background will introduce the concept of the circular economy and various business models that firms can adopt, to provide the reader with contextual knowledge. It will also examine the regulatory landscape at both regional and national levels, focusing on measures aimed at promoting circular economy initiatives and the specific goals targeted by policies and regulations.

2.1 The Concept of Circular Economy

2.1.1 The limits of linear consumption

Linear consumption follows a systematic "take-make-dispose" model, according to the Ellen MacArthur Foundation (EMF; 2013). The linear economic system has great risks to the global economy and economic growth due to resource depletion and losses, as well as increased waste. The products in the 'take, make and dispose' pattern are the result of value-added manufacturing where raw materials are turned into products through the application of energy and labour and are then sold to the end consumer, who discards the products when they no longer serve their purpose (EMF 2013). Linear consumption has over the years been increasingly attributed to rising emissions and environmental damage, such as biodiversity loss and water stress from resource extraction, pushing the boundaries of the healthy relationships of the resource-outtake to stressful levels (Circle Economy, 2023).

In the beginning of the twentieth century, Braungart and McDonough (2002) highlight in their book *Cradle to Cradle: Remaking the Way We Make Things,* how the linear economy is bound to its idea that resources are infinite, and that supply will not decline. These assumptions bring the economic model to an overuse of the planet's assets, resulting in a miss in addressing the pollution and emissions generated in the production, subsequently leading to waste accumulation (Braungart & McDonough, 2002). Other limits in the linear economy, due to the satisfaction of linear consumption needs, relate to economic inefficiency because it does not capture the full value of materials and resources. Instead of reusing or recycling materials, they are treated as disposable, resulting in lost economic opportunities and higher costs for society (Braungart & McDonough, 2002; Pearce & Turner, 1989). Energy inefficiency and waste generation also have large social and environmental costs because the linear economy often involves energy-intensive processes for extraction, manufacturing, and transportation, leading to high energy consumption and greenhouse gas emissions. The waste generation is one of the greater problems and limitations of the linear economy, which affects the environment in several ways, both through resource depletion when the materials are not reused, but also through pollution when many products end up in landfills or incinerators leading to littering, pollution of water and soil, as well as ineffective use of land (Braungart & McDonough, 2002).

During the last 15 years, companies have noticed that the linear system also increases the potential risk and threats, such as increased resource prices and volatile pricing in the raw material markets (EMF, 2013). The price volatility is likely to remain high due to resource

extraction relocating to more inaccessible locations due to scarcity, as well as a larger demand for critical raw materials, such as precious metals. Due to this, the search for a more sustainable industrial model has increased the interest of companies in closed-loop systems, where unlimited resources such as labour play a greater role than limited natural resources, in hopes of decoupling sales revenue from material needs (EMF, 2013).

2.1.2 From linear to circular

The idea of circular economy (CE) is to replace the traditional 'end-of-life' model with a focus on reducing, reusing and recycling products and materials (Berg et al. 2018). Therefore, the central concept or theme of CE can be defined as the evaluation of materials within a closed-loop system that allows sustaining economic growth and simultaneously allowing the use of natural resources while reducing pollution or avoiding resource limitations (Winans et al. 2017). The point of CE is to create a balance in relation to our resources and materials, contrary to the linear economy, which is reliant on infinite resource allocation, to relieve some of the environmental pressure (Circle Economy, 2023). Although its various definitions over time, rooted in natural economics and resource management, the broader definition of the concept was formalized and popularised by the Ellen MacArthur Foundation in the 21st century, mainstreaming the concept, raising awareness, and catalyzing action through research, initiatives, and collaborations (EMF, 2013).

The Ellen MacArthur Foundation (2013) emphasizes the restorative and regenerative goals within the context of CE, which refers to CE as an industrial system that can be restorative or regenerative by intention and design. Restorative focus emphasizes the repair and revitalising of ecosystems and resources that have been degraded or exploited by human behaviors, to return the system to a state where it can function as it used to do, where its essential environmental services are functioning again. Examples of restorative activities can include reforestation, habit restoration, and community development projects, with the aim of improving social and environmental well-being (EMF, 2013). Instead, the design of a regenerative system focuses on creating a system where it can restore and revitalize itself or even reach higher levels, creating a resilient ecosystem and not only undoing harm (EMF, 2013; Morseletto, 2020). Based on these definitions, the goal of moving from the linear to the circular economic system is to move to a regenerative system approach.

One common way to visualize the idea of CE is through loops as Ellen MacArthur Foundation has done with the butterfly diagram, dividing the circular economy into the biological cycle and the technical cycle, illustrating the continuous flows of materials through the two main cycles of society (EMF, 2022). On the left-hand side, the biological cycle is explained, which is focused on materials that are biodegradable and therefore can return to Earth safely (EMF, 2022). On the right-hand side is the technical side, aimed at products, rather than materials, that are being used and not consumed. Some materials may eventually end up in both loops, but for most products or materials, they are found in one of them. The inner loops on both sides are where most value can be captured and should therefore be the loops to strive for; the strategies for reaching these loops will be elaborated on in the next section covering the 9R

framework. The technical side will be the focus in this research because it is in these loops that the business of the case study acts. The butterfly diagram is a good visual representation for understanding the principles and benefits of the CE concept, showing that systems and products designed for circularity are needed to reduce the environmental impact of the linear economy (EMF, 2022).

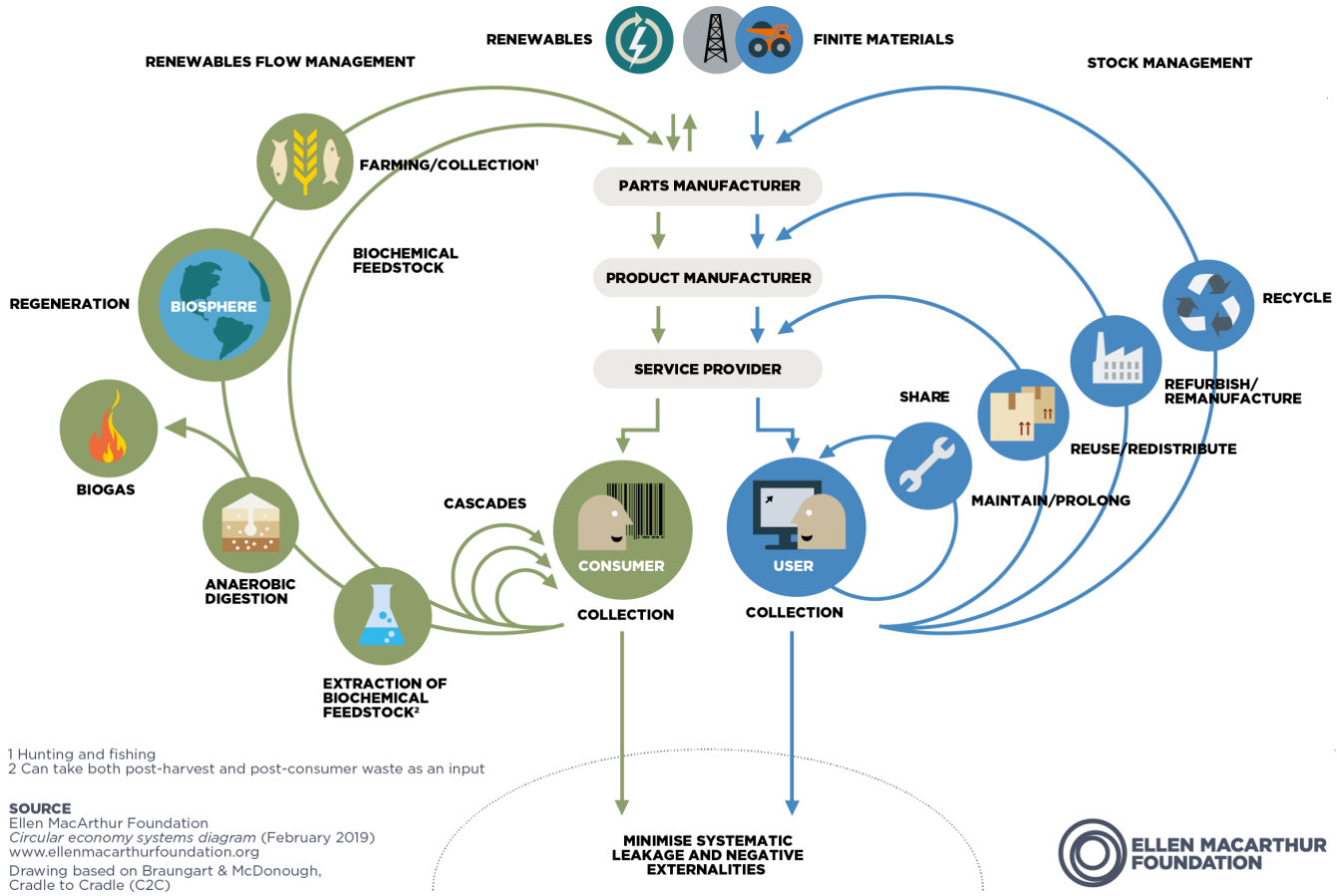

Figure 1. The Butterfly Diagram, sourced from EMF (2019).

2.1.3 The 9R framework

A common approach for business models in the circular economy is to attach the strategy to the different loops of the CE concept, shown in the butterfly diagram, to modify the pattern of resource flows and material use (OECD, 2018). A common framework used to describe the different strategies and principles used in the transition to CE is the 9R framework, where each of the Rs represents an action or strategy aimed at reducing waste and promoting resource efficiency. This framework has been developed over time, starting with only a few R, to later include more and more actions for the transition forward. The 9R framework, sometimes just called the R-strategies or the R-hierarchy, shows how different lengths of loops, where shorter loops tend to be more sustainable, increase the efficiency of resource use where higher up the ladder, the tighter the loop and the less material in use (Potting et al. 2017). The more circular the approach, the more environmental benefits, and a higher degree of circularity means that the materials remain in the same loop for a longer period, minimizing the extraction and production of new materials (Potting et al. 2017). The 9R framework can be illustrated as follows.

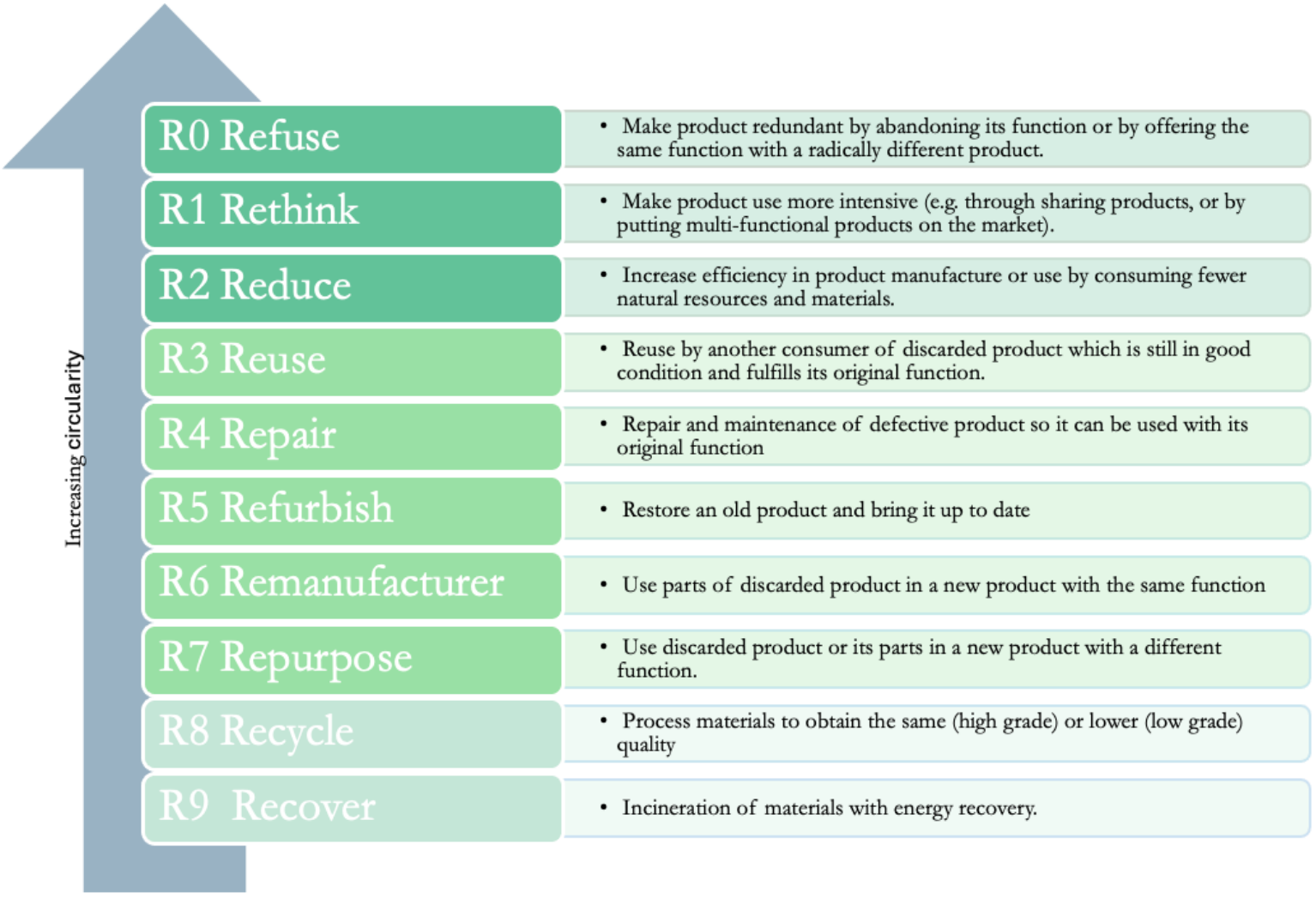

Figure 2. The 9R framework, information sourced from Potting et al. (2017).

The figure shows how the different strategies lead the transition towards the circular economy. These strategies are often the basis for the types of business models adapted by firms and organizations that want to integrate more circular flows into their operations (Potting et al., 2017).

2.1.4 Five circular business models

Business models in the field of CE, often build upon the model of the R strategies (Figure 2) connected to the closed-loop systems shown in the butterfly diagram (Figure 1). Companies can create competitive advantages through the circular use of resources when products are designed for long-term use and can later be reused, recycled, or refurbished, leading to cost savings and innovation in product design for increased modularity and multi-purpose use (Geissdoerfer, 2017). It is also a highly collaborative economic system, where relationships with stakeholders, customers, suppliers, and waste management companies must ensure a circular operation, both for the sake of financial implications but also for the sake of the environment (Geissdoerfer, 2017). Companies that adopt a circular business model are also said to build stronger resilience against the strategic challenges that affect the global market and the value chains today, which can lead to new profit pools (EMF, 2013).

There are various types of business model operating in different parts of the value chain, which is also described in the 9R model, where the different strategies are connected to different parts of the value chain. A division of business models into five different groups is commonly used, focusing on different loops in the concept. According to the OECD (2018), the groups can be defined as the following.

Table 1. Circular business models, information sourced from OECD (2018).

	Key Characteristics	Resource Efficiency Driver	Business Model Subtypes	Main sectors currently applied in
Circular Supply	Replace traditional material inputs with renewable, biobased, and recovered ones	Close material loops	Cradle-to-cradle	Diverse consumer product sectors
Resource Recovery	Produce secondary raw materials from waste	Close material loops	Industrial symbiosis, recycling, upcycling and downcycling.	Metals, paper and pulp, plastics.
Product Life Extension	Extend product life	Slow material loops	Classic long life, direct reuse, repair, refurbishment and remanufacture.	Automotive, heavy machinery and electronics.
Sharing	Increase the utilization of existing products and assets	Narrow resource flows	Co-ownership and co-access	Short-term lodging, transport, machinery, and consumer products.
Product Service System	Provision of services rather than products. Product ownership remains with the supplier.	Narrow resource flows	Product-orientated, user-orientated, and result-orientated	Transports, chemicals, and energy.

Although in theory, the division of these models is quite distinct, a firm can adopt combinations of these models, offering different services that combine the strategies of more than one business model (OECD, 2018). Shown in the table, based on the OECD (2018) report on circular business models, the application of the model and key characteristics, as well as the main sectors, are highlighted to gain a deeper understanding of the models. In this study, the focus will lie on the Product Life Extension (PLE) and its implications, but it is still important to acknowledge the other business models as well, to gain a more comprehensive understanding for how businesses in circular economy can steer their operations through different strategies.

2.2 Policies and Legislation Driving the Transformation Within the European Union

The European Union implemented the Green Deal of the European Commission in 2019 in which the EU seeks to become a climate-neutral continent by 2050 using the initiative as an agenda for sustainable growth (European Commission, n.d.; Ernst & Young, 2022). In the Green Deal, the EU adopted the Circular Economy Action Plan in 2020 which is one of the main blocks of the Green Deal. With the transition to CE, the EU hopes to relieve pressure on natural resources, as well as create sustainable jobs while ensuring material and energy efficiency, to reach the targets of the Green Deal (European Commission, n.d.). The circular economy action plan includes several policy measures and an instrument to embrace the transition toward a more resilient economy, by bringing forward new policy proposals, as well as revisiting obsolete principles (EY, 2022). In the action plan, there are 35 actions listed, and one of the main actions is the New Sustainable Products Initiative, whose objective is to revisit the existing eco-design framework and to include more circulate measurements, as well as implement digital product passports to trace materials and products within the EU (EY, 2022). The included proposals will also strengthen consumer rights and reduce misleading information, often called greenwashing, to ensure that customers get information on the durability and repairability of all products. To begin with, the plan will first focus on sectors that use a lot of materials and sectors where there is a potential to become more circular, including sectors such as electronics and ICT, vehicles, batteries, textiles, plastic, construction, buildings, water, and food (European Commission, n.d.). To follow up and monitor its progress, a monitoring framework for the circular action plan also exists, which will monitor material and resource efficiency and use and simultaneously monitor the consumption footprint, in relation to the planetary boundaries of the EU consumption (European Commission, n.d.).

The EU Taxonomy is a system developed by the European Union to classify economic activities according to their environmental sustainability. It was introduced as a key component of the EU's sustainable finance initiative, and the Taxonomy Regulation took effect in July 2020. This framework offers a standardized approach to identify which economic activities meet criteria for environmental sustainability (EY, 2022; European Commission, n.d.). In relation to CE, the Taxonomy includes disclosures on circular economy and resource efficiency, to redirect investments towards sustainable activities, which in turn can steer investments towards circular initiatives and businesses (European Commission, n.d. b). One of the criteria in the EU Taxonomy Delegated Acts is transitions to circular economy, meaning that the transparency tool marks initiatives fulfilling this specific criterion, as good to invest in, for a greener transition and a more resilient future (European Commission, n.d. b)

Circular initiatives and guidelines can also be found in other international agreements, such as the 2030 United Nations Agenda, where the interconnection between the implementation of the goals and the transformation toward CE is highly intertwined (UN, 2015). The recognized benefits of CE are also of importance to and part of several goals in Agenda 2030, creating an interdependent relationship where the goals can be achieved with the help of CE, at the same

time as the goals also encourage and drive the transformation towards CE (Khajuria et al. 2022). CE can therefore be said to drive both the need for further legislation and agreements, but also be a desired result out of it, making it a complex and contradictory transformation (Khajuria et al. 2022). The OECD also has projects in circularity, where its RE-CIRCLE project provides policy guidance in resource efficiency and circular economy. Its goal is to assess and measure the effects of resource-efficient circular economy policies, providing guidance to various stakeholders in member nations of the OECD and emerging market economies through both quantitative and qualitative analysis (OECD, 2022).

2.2.1 The regulatory landscape in Sweden

As Sweden is a part of the European Union, it must adhere to the regulations and agreements enacted by the EU. However, Sweden is also permitted and encouraged to develop its own policy instruments and guidelines on a national level to drive the transition towards a circular economy. The Swedish government has proposed a strategy for the transition to the circular economy, as well as two action plans, one general and one specific targeting the use of plastics. The goal within the overarching strategy is to achieve the environmental and climate goals on a national scale, as well as contribute to the fulfilment of the Agenda 2030 goals, on a global scale (Government Offices of Sweden, 2020). To achieve these goals, the government has developed a vision, namely that resources must be used efficiently in nontoxic flows and must replace virgin materials. The action plan is divided into four different focus areas, which will cover production and product design, sustainable consumption, nontoxic and circular cycles, and circular economy in business life, innovation, and in business models. For each focus area, milestone goals have been developed, quantifiable goals that must be met in relation to the climate and environmental goals that the Swedish government has developed. The specific action plan for plastics must ensure that the cycle of plastic use becomes more circular to deal with the problems that exist in today's increasing use of plastics and the littering of plastics that occurs to an all too large extent. Despite the action plans, there are not many direct guidelines and regulations for the Swedish transformation from the government (Government offices of Sweden, 2020;2021;2022).

To drive the transition, both private actors work with circular initiatives, but also authority committees and research institutions to support the government and develop approaches to facilitate and drive transitions in the corporate world (Government offices of Sweden, 2020). Sweden's government is also involved in the Nordic Council of Ministers, which has drawn up a circular strategy for the Nordics with a focus on green growth and sustainability. The Prime Ministers in the Nordics have a vision that the Nordics will be the world's most sustainable and integrated region by 2030. The cooperation in the Nordic Council of Ministers will contribute to achieving the goal (NCE, 2023).

2.3 The Case Firm Godsinlösen AB

In this section, the case firm of the study will be elaborated on, including their activities and operations. All information is sourced from the company itself, through their website, annual reports, their employees, or through other internal sources.

Godsinlösen AB (GIAB) is a small Swedish company with approximately 50 employees located in Staffanstorp, in southern Sweden, near Lund and Malmö. GIAB's mission is to create profit and experience economic growth without negatively affecting people and the planet, acting as an accelerator of positive change, while promoting more sustainable consumption through reuse. Through their product life extension business model, GIAB helps retailers and manufacturers reduce their ecological footprint by reselling products that would otherwise be discarded. By promoting reuse, GIAB contributes to more efficient resource utilization, which in turn supports a more sustainable future and reduces resource surplus and waste for its partner companies.

GIAB acts as a bridge between the retailer and the customer, reselling products through different channels. This approach creates profits through sustainable methods while keeping products in circulation instead of replacing them with new resources. Since GIAB is a profit-driven firm, the products they resell must contain some form of economic value or have value added through repair or refurbishment. Products come from various retailers and are often returned items due to defects or the right to withdraw, making them unsellable by the original retailer. Sometimes, the products come from residual stock or insurance cases. GIAB operates by reselling these products, saving both economic value and reducing environmental impact for the retailer. The main suppliers of goods are Swedish companies, both in-store and online, in sectors such as electronics, home improvement, hobby and leisure goods, wholesale stores, as well as children's products and clothing. The analysis will focus on two retailers from different sectors as an alternative perspective in relation to product categories. To protect the interests and privacy of their business relationships with GIAB, retailers will not be named, but their characteristics and focus on product categories will be briefly explained.

After GIAB receives the products, they undergo a process of reconditioning, grading, and assessing the potential value depreciation before returning them to the market through their sales channels. Currently, GIAB offers sales through its own e-commerce platform, Returhuset, as well as their physical store. Additionally, sales are conducted through the Swedish auction site Tradera and other suitable channels for more specific cases. GIAB's return management service is facilitated through their digital platform, Circular Platform™ and Planetary Model™, enabling efficient product handling and calculation of the environmental savings involved. Each month, GIAB delivers a sustainability report to all clients, presenting data, statistics, and results, including the environmental and cost savings achieved.

GIAB also collaborates with insurance and logistics companies. Where they provide electronics repair services in insurance cases and if a product is not repairable, they replace it with an equivalent repaired product for the customer. Products that cannot be repaired or resold

are disassembled for spare parts or appropriately recycled. From logistics companies, GIAB receives packages and goods that have either lost their owner or have not been picked up; therefore, GIAB resells these products instead of letting them be discarded. Their diverse range of partner companies results in a wide variation of products in terms of categories, condition, and quantity, leading to a sometimes unpredictable and varied product flow.

The product categories that will be analyzed in this study are derived based on data availability and categorized with their internal categorization used in their online store. The following four categories will be the basis for the analysis:

Mobiles & Accessories (Iphone, Samsung, mobile accessories, other mobile phones)
Home electronics (computers, photo and video, speakers, headphones and headsets, meeting rooms, tablets and accessories, TV, video games, other home electronics)
Hobby & Leisure (Building and tools, books, bikes, film and music, pets, collectibles, sup boards)
Home & Interior (bathroom accessories, lighting, household, interior design, furniture and storage, crockery and table settings, garden, heating and cooling, other)

Table 2. Godsinlösen AB's product categories.

2.3.1 GIAB and the 9R framework

In the 9R framework by Potting et al. (2017), the main strategies used by GIAB are in the middle of the figure, specifically R3-R7 (reuse, repair, refurbish, remanufacture, and repurpose). These strategies are related to activities that extend product lifespans and are commonly applied in sectors such as electronics, machinery, and automotive, as observed in Circular Business Models by the OECD (2018) in Table 1. Depending on the products GIAB receives and their condition, the strategies may vary but are still used within the PLE business model.

In the PLE business model, different approaches are adopted, which also correspond to the various R3-R7 strategies in the Potting et al. (2017) model. Furthermore, the OECD explains the different approaches to the PLE business model, how they create value, and their key characteristics. GIAB's organizational activities encompass three of the four approaches listed in Table 2 under Product Life Extension, namely the last three: direct reuse, maintenance and repair, and remanufacturing, with the first two being their most common activities. Through these activities, GIAB creates economic value by reselling products that would otherwise be discarded, fixing, and replacing defective components, restoring products, or using their components as spare parts for future repairs. In this operation, GIAB leverages cost savings by profiting on products that would otherwise be discarded, a concept known as gap exploitation.

2.3.2 Condition classification system

When GIAB receives goods from various suppliers and partners, they are inventoried and registered in the sales system. Initially, products are classified according to a standardized condition classification system developed in collaboration with various firms in the re-commerce industry, according to the Hållbar e-handel classification guidelines (Sustainable e-commerce) guidelines, seen in Figure 3 (Hållbar e-handel, 2023). Before this standardization, GIAB used a similar condition-grading system, considered comparable in assessment, and thus can be used under the same framework. Following inventory, some products, primarily electronics, undergo functional testing to verify if their initial condition grading aligns with their functionality; if not, the grade is adjusted in the system. Subsequently, during the product listing, sales staff performs an additional condition check to ensure that the appearance and packaging match the stated condition rating. While the condition classification is created for used electronics, it is also applicable to other product categories. The price of the product is determined based on current conditions and other attributes such as model, brand, age, and original price. The time taken for the product testing and overall handling, including inventory and stocking, is also recorded in the sales system.

Figure 3. The condition grading, based on information from Hållbar e-handel (2023)

2.3.3 Resell channels

GIAB operates in-store and online, providing extensive access to reused products for a diverse range of customers. Their physical store, Returhuset (The Reuse House), is in Staffanstorp, near Lund and Malmö in the southern region of Sweden, as well as in proximity to several smaller neighbourhoods. Their online presence includes their own platform and webshop, as well as participation in online auction sites, primarily the Swedish website Tradera, which caters to private customers. In addition, some products are sold to companies through B2B sales channels, either through direct contact with other companies or through auction sites designed for B2B transactions. The choice of the sales channel depends on the characteristics of the product, such as size and condition. Generally, products in better condition are sold on GIAB's online store, while those in slightly worse condition are listed on Tradera, as pricing for these items is more reliant on the consumer's willingness to pay. Larger items or bulk orders are often be sold in the physical store due to logistical constraints or to complement the online inventory.

2.3.4 Market characteristics and competitors

To understand what consumers face when looking to buy reused or more environmentally conscious products, this section will provide brief information on the characteristics of the market and competition. The market where GIAB operates spans both national and local scales, through Swedish online platforms as well as their physical store in Staffanstorp. Direct competitors offering a similar range of products that are also functionally tested and condition-graded prior to sale are scarce in the nearby area. Although conventional second-hand shops can compete in price, they typically lack the offering of functionally tested and repaired products, often selling items in their existing condition and of lower quality. Similarly, other auction houses tend to focus on vintage furniture or high-end interior design, focusing on a slightly different segment of products and customers.

Online, GIAB faces more competition from companies like Inrego, Refurbed, and Rekomo, each of which specializes in reused and refurbished products within specific categories. Inrego focuses on IT products, including mobile devices, computers, and tablets, serving both the B2C and B2B segments. Rekomo offers reused office furniture for sale and rental, primarily aimed at B2B customers. Refurbed primarily deals with electronics and IT products, operating more as a marketplace where different firms can resell refurbished electronics. Additionally, platforms such as Blocket and the Facebook Marketplace also pose competition, as customers often use these platforms to search for lower priced reused products. It is challenging to accurately outline the competitive landscape in the market due to the extensive and diverse nature of the Swedish reuse market, driven by environmental concerns and economic factors. Different market players serve different purposes with only partial overlap. Furthermore, consumer preferences heavily influence market demand, making it highly dynamic and sensitive to trends.

3. Previous Research and Theoretical Frameworks

3.1 Creating Value with a Product Life Extension Business Model

The Product Life Extension Model (PLE), sometimes called Extending Product Value Business Models (EPV), involves extending the life of products so that the materials in use remain in the economy for a longer period than in the traditional linear economy, potentially reducing the extraction of new resources (OECD, 2018). According to the OECD (2018), there are different approaches to follow when adopting a PLE business model, depending on the firm's operational position in the value chain. An overview of the strategies connected to a PLE model is given in the table below.

	Key Characteristic	**Business Case**
Classic Long Life	The expected life of a product is extended by changes in the design of the product.	Manufacturers can charge a premium for higher quality, more durable products.
Direct Reuse	Involves the redistribution and reuse of products that would otherwise have been discarded before reaching their expected end of life	Firms that facilitate the transactions of second-hand goods (whether online platforms or physical shops) can charge a percentage of the selling price.
Maintenance and Repair	When fixing or replacing defective components, maintenance and repair allow degraded products to reach their full expected life.	For manufacturers of original equipment, the extension of product care beyond the point of sale may help promote customer loyalty. In addition, repairing existing products can be a profitable activity for third-party repair firms.
Refurbishment and Remanufacturing	Gives products a "new life" by restoring them to their original working condition	Refurbished or remanufactured products are sold at a lower price than new ones, but may generate higher profit margins due to material cost savings.

Table 3. Product Life Extension Business Strategies, information sourced from OECD (2018)

Firms and organizations adopting a PLE business model can use the strategies simultaneously depending on the condition and status of the products. It is not necessarily the manufacturer of the product that undertakes these strategies; instead, it is often third-party operators that reuse, carry out repair, refurbishment, or other remanufacturing activities (OECD, 2018). When using already existing materials and products, third-party operators use the cost savings, making profits on reselling the products without the need to manufacture them. The implications of these strategies in PLE are slowing or closing circular loops, which is highly dependent on the manufacturer's product design and the reparability and modularization of the products (Bocken et al. 2016).

Extension of product value is one example of slowing down the circular loops of material use, exploiting the residual value of products when bringing them back from consumers or businesses, to later put them back on the market, to prolong its economic value (Bocken et al. 2016). Through this, companies can capture new forms of value while reducing material costs,

which can ultimately reduce the overall cost of handling products. In areas where manufacturers do not use these business models themselves, there are attractive gaps for third-party firms to exploit their products (Bocken & Short, 2016). Although it can lower overall costs, initial costs for labour and logistics can potentially increase, depending on the product category, as well as the firms' specific value chain and their needs (Bocken & Short, 2016).

To understand the scope and application of this type of business model, Bocken et al. (2014) define the three main elements in a business model that can provide a guide in identifying the main activities and how the economic value is created in a firm. The model is developed with an additional sustainability perspective but originates from Richardson (2008) and Osterwalder and Pigneur (2005) *conceptual business model framework.* The sustainable business model (SBM) framework incorporates not only the value for the stakeholder but also the environment and society, which makes it applicable to business models in CE where value capture is important for society and the environment as well (Bocken et al. 2014). The SBM framework defines the *value proposition, the value creation & delivery,* and *the value capture* as the main elements in a business model where the value proposition is often seen as generating an economic return, but in the sustainability version, there is also a return on ecological or social value (Bocken & Short, 2016). The framework can be seen in the following figure.

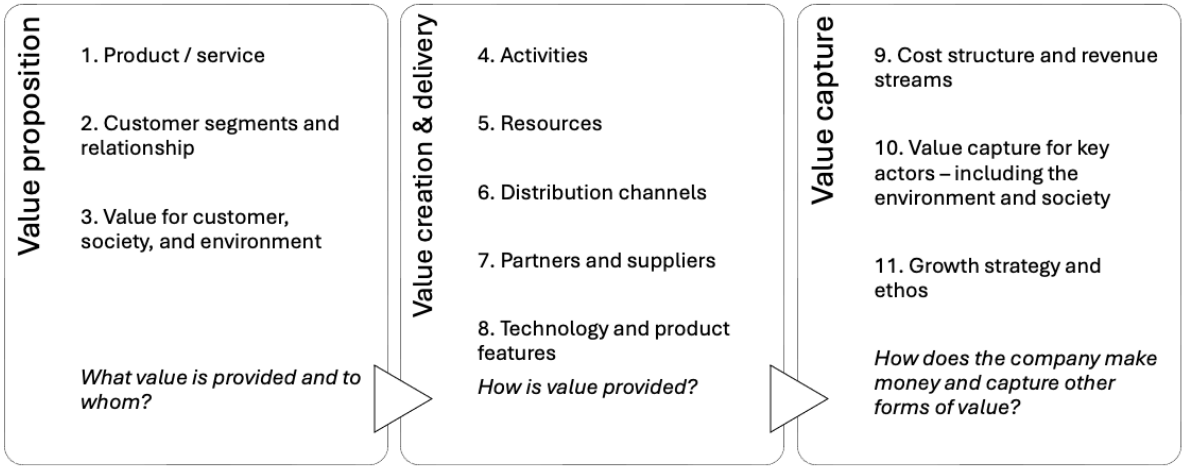

Figure 4. Sustainable Business Model Framework, information sourced from Bocken & Short (2016).

Bocken et al. (2016) connect the framework to a PLE business model, highlighting the type of value that can arise. The *value proposition* for a firm using PLE strategies is centered on third-party organizations, or original manufacturers, exploiting the residual value of the product and then delivering a product to the customer, which is remanufactured, repaired, or in used condition, to deliver affordable products (Bocken et al. 2016). There is also a value to the environment that products are being reused instead of discarded, possibly decreasing the use of new materials. *Value creation and delivery* include collaborations with stakeholders such as customers or retailers and logistics companies, to ensure take-back systems or other ways to enable consistent product flows (Bocken et al. 2016). Firms using a PLE strategy or business model capture *value* through the reuse of materials and products that otherwise would be discarded, which can lead to a decrease in overall costs, making it an attractive business model compared to traditional manufacturing. There is also value captured for society and the

environment, making it attractive strategies for firms wanting to create a lower impact on resources and taking a responsibility (Bocken et al. 2016).

Economic value creation can also be directly related to product interaction, where firms typically add value to the product with or without interaction to reverse product obsolescence (Whalen, 2020). Firms can have varying degrees of interaction, sometimes a mix depending on specific product categories, creating different types of value-adding activities in the SBM framework. The level of interaction between firm and product in the value creation step can be seen as the following scale.

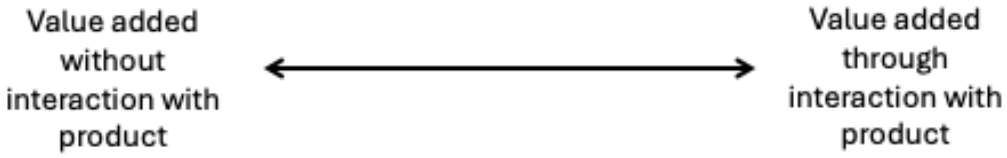

Figure 5. Product Interaction Scale, information sourced from Whalen (2020).

Firms with low interaction with the product (to the left) are usually called *facilitators,* as they only act as platforms or marketplaces for reselling goods (Whalen, 2020). In the middle and more to the right, the *redistributors* and the *doers* are active, with a higher degree of product interaction, adding value through redistribution or through both redistribution and remedial action on products such as repair and refurbishment (Whalen, 2020). Firms usually have activities related to multiple value propositions, which is why the product interaction is shown as a scale, indicating that economic value can be added depending on the specific needs of the products. Depending on what activities the firm engages in, the SBM frameworks take on a slightly different *value proposition, value creation and delivery, and value capture* depending on the product interaction (Whalen, 2020).

3.1.1 Knowledge from SMEs using PLE models

Various researchers have explored the PLE business model, highlighting its potential for both sustainability, profitability, and value creation in theory. But few studies investigate the implications of the model when it has already been adopted by a company and what the challenges and barriers are in the long run, both internally in the firm's operations and also externally, in relation to consumer behaviour, with a focus on selling already manufactured products and what characteristics of the products that matter. This section will introduce previous case studies of PLE business models in small and medium enterprises (SMEs) in the European context and what findings the researchers highlighted considering the firms' barriers both internally and externally. Given the area's rise in recent years, information and research are somewhat limited and often generalized over different types of circular business models, whereby detailed studies of specific companies and mechanisms in specific business models such as the PLE models are in many cases lacking, which this study intends to contribute to.

A study by Vermunt et al. (2019) conducted in ten Dutch PLE firms divides the difficulties found in the implementation of the PLE business model into internal problems related to the firm itself, as well as external barriers related to the firm's environment. The cases showed that most of the barriers found were related to the external environment and in the ten firms that adopted a PLE business model, the main obstacles were related to market barriers and supply chain barriers. One-third of the firms also mention that financial, organizational and knowledge and technology are internal problems when advancing with a CBM (Vermunt et al. 2019). Supply chain barriers were mostly related to the unknown condition and quality of the discarded products and the dependence on partner companies that did not have a circular focus, resulting in the discarded products arriving in a poor state, making it difficult to generate value (Vermunt et al. 2019; Guldmann & Huulgaard, 2020). The dependence on other firms in the value chain also creates uncertainty of the timing and volume of what products to arrive, creating difficulties in handling and stock- and inventory efficiency, making it harder for the firm to operate, creating planning difficulties and demand conflicts. Products lacking a modularized product design also proposed challenges, placing demands on the technology and skills of the firm, to be able to repair and disassemble the products, increasing the workload of the PLE firm (Vermunt et al. 2019). When repairing goods, original spare parts can be difficult to attain because of long transportation and specialized manufacturers, the rate of technology development can therefore also be a barrier because the newer product designs require different input parts than older ones, leading to logistics barriers (Guldmann & Huulgaard, 2020).

Both Vermunt et al. (2019) and Guldmann and Huulgaard (2020) also discuss market barriers, where it is identified for case-studied firms that market demand is unclear, leading to uncertainty and difficulty in penetrating and reaching the intended market. Market demand is affected by consumer preferences and behaviour, where Ylä-Mella et al. (2015) found that consumers generally have a mixed attitude towards reused, refurbished, or repaired goods, giving them a lower status compared to new goods. The uncertainty of the residual value of the products makes consumers skeptical, leading to unclear market demands. Another barrier, frequently mentioned by Vermunt et al. (2019), Guldmann and Huulgaard (2020), as well as Rizos et al. (2016), are financial barriers, lack of capital, and support from financial institutions. Especially for SMEs, the lack of turnover means that banks are hesitant to release funding, making it difficult to run the core business with the technology and knowledge required to be a circular actor. Rizos et al. (2020) also highlight the absence of government support and effective legislation as a significant obstacle. Small and medium enterprises (SMEs) face greater challenges in adhering to environmental regulations compared to larger corporations, often due to a lack of awareness of relevant legislation. Additionally, regulatory frameworks can breed uncertainty, further complicating compliance efforts. This barrier was noted by a quarter of the SMEs surveyed by Rizos et al. (2016), particularly those grappling with inconsistent government support, leading to uncertainty regarding policy changes and continuity. However, companies that have established conducive conditions for embracing circular business models may find themselves less dependent on government aid to craft appropriate operational frameworks.

3.1.2 Product longevity and reusability

The characteristics of the products that are desired in the PLE models are characteristics such as durability, quality, and functionality, because the economic value tends to remain higher through its use (Lacy & Rutqvist, 2015). It has long been the goal of companies to focus on volume and produce as much as possible at the lowest possible cost. But since environmental issues and resource depletion became a much more apparent issue, companies instead began to turn to PLE models, both to save money and to use the planet's resources. But this type of business model creates value through reusing products and materials in different loops, and requires other product characteristics and design for the best possible outcome for a longer time (Lacy & Rutqvist, 2015). Altered manufacturing methods and handling needs therefore place demands on product design, where repairability and modularity are desired to be able to more easily replace, renew, or fix products in the future.

Lacy and Rutqvist (2015) identify how companies are designing and adapting their products for a longer product lifetime. Electrolux, which sells commercial appliances, uses modularity and fewer materials to create products that can be easily repaired and reused. Since this can increase the price of a product, high-quality products are often easier to integrate into a PLE business model than low-end ones (Lacy & Rutqvist, 2015). Not every product is a good fit for this business model, some products cannot be designed for modularity or require more expensive materials, which makes them hard to repair or remanufacture and with additional costs in handling. The same with goods that in consumer eyes are tied up to trends, like clothing and interior, that cannot be upgraded through add-ons or remanufacturing, are hard to resell because of their decrease in demand and embedded value over time (Lacy & Rutqvist, 2015).

Bakker et al. (2014) put great emphasis on that the problem in many cases is the initial product design and material use and that there is a lack of expertise in the product design step that does not facilitate a longer product life or the possibility of reuse. Bakker et al. (2014) presented a table on the median lifetimes of a selection of household products based on data from 2000-2005, showing a decrease in the useful life of almost all products. Small consumer electronics and accessories, according to the data, have decreased their useful life by almost 20 % over the 5-year period analyzed, making the value of the products to decline rapidly. But the reasons behind the decline in product life do not necessarily depend only on function and design, but often what is called 'planned obsolescence' (Bakker et al. 2014). There are also other factors that affect the shelf life and value of a product, such as market competition, legislation, and customer expectations, forcing manufacturers to present new products to keep up with business rationale in the fast-paced society of today. Some product replacements are also argued to be eco-effective, as products such as refrigerators with high energy use should be replaced after certain years to increase the house-hold energy efficiency, and therefore the trend of decreasing fridge lifespans might be a positive development in the light of energy efficiency (Bakker et al. 2014).

"*The optimal product lifespan is the point in time where the environmental impacts that arise from using a product are equal to the embedded impacts of a replacement product" (Bakker et*

al. 2014). Therefore, optimal lifespan and longer reuse period might not be the most environmentally effective alternative for all types of products and should perhaps not be encouraged through reuse.

Consumer preferences, which will be elaborated on below, also highly affect the lifespan of products, where many consumers products are retired long before their deterioration given fast-changing trends and consumer preferences (Xing & Luong, 2009). This often happens to personal computers, mobile phones, and cameras, where trends tend to decide on their use time rather than functionality and technological lifetime. This can also make some products harder to resell, not because the technology is outdated, but because their appearance to customers is not preferred anymore (Xing & Luong, 2009).

3.2 Consumer Preferences, Behaviours, and Willingness to Pay

3.2.1 Theory of planned behaviour

From a consumer perspective, consumer decisions to buy reused, refurbished and resold goods and products are influenced by various factors ranging from environmental awareness, quality, brand, and price, as well as demographic factors, all of which play an important role in the decision-making process (Chen, 2020). Consumer inclination for used products is complex, and previous research has shown that factors that affect decision making, as well as willingness to pay (WTP), can be different when it comes to online versus in-store purchases (Kwarteng et al. 2018). The results of the research by Kwarteng et al. (2018) in the Czech Republic indicate that with respect to online purchases of used electronics, a motivating factor is how many years in use or condition, in combination with the affordability of the price.

Willingness to pay (WTP) is an economic term that describes the maximum price at or below which a consumer has the will to buy one unit of a specific product. The WTP is, of course, complex and can also be conceptualized as a range or a relative number, in relation to factors that affect the WTP (Pretner et al. 2021). The WTP is also affected by the type of goods and their relation to both income and price elasticity that are being resold, meaning consumers' sensitivity to price changes as well as their buying habits related to changes in income. The entire PLE business model is highly dependent on consumers wanting to buy the specific products offered by the firm, which makes their WTP and their intention to purchase very important to understand (Agostini et al. 2021). Some consumers tend to have concerns with buying goods in closed-loop activities due to low quality perceptions, as well as undesirable attributes (Agostini et al. 2021).

A theory used in previous literature to structure WTP and the perception and behaviours of consumers in circular or closed-loop systems is the *Theory of Planned Behaviour* (TPB), which investigates consumer purchasing behaviour from different angles (Groening et al. 2017). TPB is a psychological theory that explains consumer behaviour in terms of four key factors, namely: *Attitudes, Subjective Norms, Motivations, and Marketing Mix Variables,* and how

these key factors describe the intention to buy circulated products (Jimenez-Parra et al. 2014). Jimenez-Parra et al. (2014) exemplifies the TPB model and connects it to consumer intentions to buy a refurbished or remanufactured laptop and describes what factors might influence the intention.

The first key factor in the model is the *attitude towards purchase* (AP), in which the consumer attitudes towards the specific refurbished product are analyzed. Consumer attitudes towards reused and refurbished goods play a significant role in their purchasing decisions. Positive attitudes are often driven by factors such as environmental awareness, cost savings, and perceived quality of products. For example, consumers who prioritize sustainability can have a positive attitude toward buying reused goods due to their lower environmental impact (Jimenez-Parra et al. 2014).

Second, the *Subjective Norm* (SN) describes the social influence that shapes consumers' intentions to buy refurbished or reused goods. It is related to the social pressure that the individual consumer perceives from others, affecting whether they perform a certain behaviour (Jimenez-Parra et al. 2014). The *Subjective Norm* can therefore be what people close to the consumer think about their choice and behaviour and if they should buy already used products or not. If there was a stigma associated with buying a specific type of product in the consumer's social circle, it could deter the consumer from proceeding with the purchase (Jimenez-Parra et al. 2014). Buying second-hand and reused goods is often associated with environmental and economic awareness, and if consumers perceive that their peers, friends, or family members support and participate in buying reused products, they may be more inclined to do the same.

Third, the variable *Motivations (M)* describes the reasons that can lead to why the consumer performs the behaviour, such as buying a refurbished product at some time in the future. One motivation could be that the refurbished product has a lower price than the original, creating economic incentives (Jimenez-Parra et al. 2014). Consumer motivations are also affected by accessibility, product availability, and perceived ease of purchase. If consumers perceive buying reused goods as convenient and accessible with a wide range of available options, they are more likely to consider them as viable purchasing options. Factors such as product warranties, return policies, and trust in the refurbishment process can also affect motivations (Jimenez-Parra et al. 2014).

Lastly, the framework incorporates *Marketing Mix Variables* (MMV), which is highly related to motivations, since the marketing mix includes price, product, promotion, and distribution, as they influence the consumer’s intention to purchase. It is also a way for companies to create a relationship with customers and affect their attitudes, norms, and motivations as a marketing tool (Jimenez-Parra et al. 2014). The variables in the marketing mix that have been shown to be important when selling refurbished products are according to Jimenez-Parra et al. (2014) characteristics associated with the product, such as quality, brand, and performance, but also price and distribution channel, which affect its accessibility.

Throughout the development of the adapted TBP model by Jimenez-Parra et al. (2014), their research was quantitatively tested on a large sample, wanting to buy a refurbished laptop, suggesting that consumers are driven by an environmental consciousness and therefore value the opinions of the social circles in their purchasing decisions. Additionally, consumers consider both the price of the product and the reputation of the original manufacturer as important factors in their decision-making process. Understanding these variables, price, brand reputation, motivation, attitude, and social influence, helps explain why people express interest in purchasing reused and refurbished goods, allowing companies to tailor their strategies accordingly (Jimenez-Parra et al. 2014).

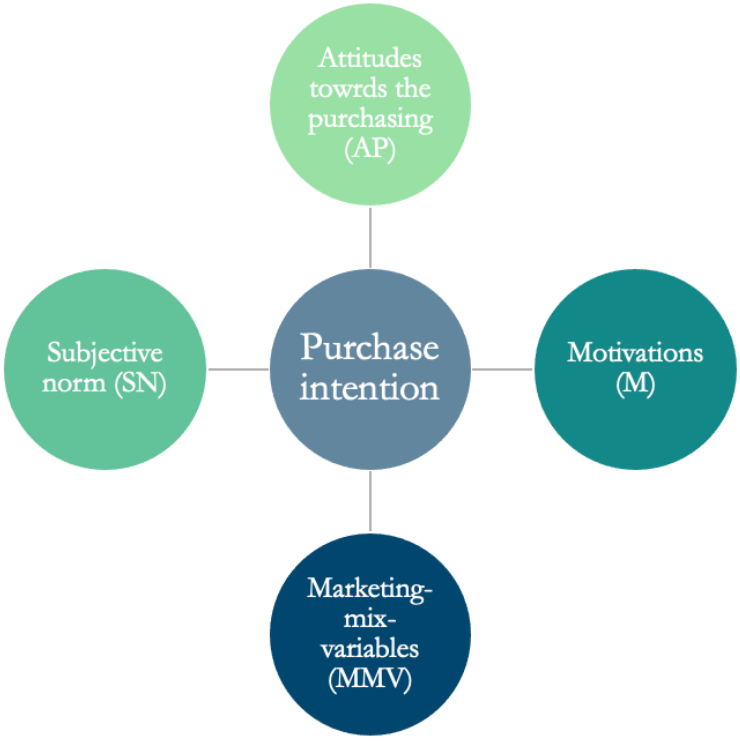

Figure 6. Theory of Planned Behavior, sourced from Jimenez-Parra et al. (2014).

3.2.2 Classification of goods

Goods and products can be classified into various categories based on different criteria. One common classification in the field of microeconomics, to highlight consumer behavior between different types of goods, is to reflect upon the income elasticity and how changes in consumer income affect the demand of different products, which can give insights about the market trends and consumer behavior. The economic classification of goods can reflect how consumers act in times of economic downturns or what characteristics are more important in relation to income changes. In this case, the relevant product classification will be *normal* and *inferior,* representing different types of shifts in demand when income increases or decreases.

Depending on what classification the good falls into, it affects the consumers WTP, when the income or economy experiences economic up- or downturns (Kenton, 2023). Normal goods are products that consumers buy more of when income increases, increasing the demand for

goods in times of economic upturns. Therefore, normal goods have a positive correlation between income and demand, which is generally true for goods such as food, clothing, electronics, and household appliances (Kenton, 2023). Normal goods have a positive income elasticity, which measures how the quantity purchased changes with changes in the income, in this case moving in the same direction.

The opposite to normal goods, are referred to as inferior goods, are goods whose demand drops as consumers income rises, and in the other way when the income decreases. Inferior goods often refer to affordability and include goods that people purchase because they cannot afford higher-quality or higher-price substitutes (Kenton, 2023). Inferior goods can sometimes refer to the brand purchased or how something happens, such as public transportation, buying second-hand, or choosing lower quality substitutes (Kenton & Kelly, 2023). There is not a clear line between the division of inferior and normal goods, and when it comes to buying reused or refurbished goods, its somewhat dependent on the product category where refurbished electronics or reused furniture can fall into the categorization of normal goods, of which people tend to buy more of or buy new ones when the economic times are better. Although income increases, many people still prefer to buy reused goods due to affordability or environmental awareness. Some reused goods can also fit into the category of inferior goods, goods whose demand increases when income decreases, which typically second-hand purchases fall into, especially if they are perceived as a lower quality substitute, such as in worse condition than new items, when the resell prices are marginally lower than the original price.

3.2.3 Consumer price sensitivity

Consumer WTP can also be described through the elasticity of the consumer's price, which measures the response of demand to price changes, which in this case can relate to the price reduction that typically occurs when reselling products. The data in this study are not sufficient to create the measure of price elasticity, but the analysis can give an indication of how consumers relate to the retention of the price and value of specific products. The theory behind the price elasticity is important to understand in order to understand the consumer WTP and is a common measure to study in marketing and sales research.

The determinants that affect the sensitivity of the consumer price are affected by different characteristics of the market, as well as characteristics of the brand, category, and economic conditions. Bijmolt et al. (2005) defined the market characteristics that affect the price elasticity as follows. *Manufacturer brand versus private labels, Product category, stage of product life cycle, disposable income of households, country, time period, and inflation rate.* There are also demographic determinants that affect the price sensitivity of consumers, such as age and place of residence, which can affect how sensitive the consumer is to changes in price. According to Bijmolt et al. (2005), the determinant of the product category on price elasticity is more prominent in goods that are seen as durable, where a change in price on durable goods affects the price elasticity in a greater magnitude. The inflation rate of the country can also have a significant effect on the elasticity of consumer prices in the short term due to economic uncertainties.

The demand is called elastic when there is a large change in demand when there is a change in the price, which equals a measure greater than 1. If the demand is inelastic, there is a measure less than 1 and there is only a small change in demand when there is a change in price (James, 2023). Apart from the mention of determinants, the availability of substitutes for a product will also affect its elasticity; products that do not have any substitutes and are necessary to have are known to be more inelastic (James, 2023). When selling reused and refurbished goods, the reduction in price from the original price can affect the elasticity of the consumer's price positively and negatively, where demand for some products can increase and where some are more unchanged.

4. Data and Methodology

4.1 Data Source

The data originate from the case company Godsinlösen AB (GIAB), which operates under a product life extension business model. Data are extracted from their internal sales system, which records all products and includes additional information on condition, original price, retailers, resale price, sales channel, and product category, among other variables. Most of the data in the system are registered by hand, which makes it sensitive to human errors. Data were sourced as cross-sectional data for the past year to ensure as many registered data as possible and to reduce potential time biases and biases from the previously lower frequency of registration of the relevant variables, which resulted in large amounts of missing values that needed to be addressed. Data were exported as an Excel file, which was then imported into Stata18 for transformation, preprocessing, and analysis.

4.2 Final Data Set

4.2.1 Transformations and preprocessing of variables

Initially, the data set contained approximately 11,000 observations, including missing values, as well as outdated, incomplete, and incorrect data that required cleaning and sorting to strengthen the validity and completeness of the data. Furthermore, the data set contained numerous variables that were not relevant for this study. Therefore, the initial step involved selecting the most comprehensive variables to ensure the reliability and precision of the data set. Additionally, only data from approximately a year ago were used, as data collected earlier might have inconsistencies due to variations in collection systems and registrations.

Following the initial cleaning process, a further inspection of the variables was performed to determine whether any transformations were necessary, such as categorization, logarithmic transformations, or grouping. Many continuous and discrete variables exhibited significant skewness when plotted in histograms, posing challenges for statistical modelling and analysis. To address this, these variables were transformed using the natural logarithm to mitigate skewness and obtain a more symmetric distribution, facilitating linear regression. The logarithmic value of the variables also stabilized the variance in the data set and normalized outliers that could otherwise influence the results.

For categorical variables, dummy coding or numerical label coding was used according to the nature of the variable, whether nominal or ordinal. Nominal variables, such as product categories, were dummy coded, with each category represented by a binary (0 or 1) dummy variable. Variables with an inherent order, such as the condition of the product and the price level, were assigned numerical values based on their order of significance. Categorization was carried out to improve the interpretability and increase the dimensionality of the data set to ensure reliable regression. To facilitate a more in-depth analysis, new variables were created from the original to capture interactions between variables. The dependent variable, product

value retention, was derived from the original price, resell price and handling cost and serves as both a measure of how much value a product retains when reused and as a proxy for profitability. Product value retention is calculated as a percentage of how much value a product retains in the reuse process, weighing in the costs to handle or repair the product. The handling cost is determined based on the handling time multiplied by the hourly labour cost. Furthermore, the variable that indicates the turnover of stocks was calculated from the data set based on when the product was registered in the internal system and last sold. If there was more than one product, the calculation considered when the last one was sold, serving as a proxy for the duration for which the products remained in stock.

4.2.2 Data limitations

When working with data from one case firm, some limitations and bias will be present. The data set is still a relatively large sample, which reduces some potential biases, but it is still crucial to discuss and acknowledge potential problems to increase the transparency and validity of the study. Out of the full dataset, the used subset is only a small part, which needs to be acknowledged. To begin with, most of the data is self-reported into the internal system by the employees of the firm, potentially introducing a lot of human error into the data as different employees may have slightly different approaches to data reporting and the handling of the products, which can create certain inaccuracies and measurement errors affecting the results. Since the dataset was not entirely complete, and therefore a lot of observations needed to be cleaned out and the missing values needed to be dropped, the data incompleteness might affect the results, which can create an angled image that does not fully reflect the true position of the case object and their operations, which needs to be considered in the discussion.

The data are also collected from one specific period, from February 2023 until March 2024, but the earlier data also have a higher degree of incompleteness, and therefore many of the missing values are related to the earlier months in this period. This might affect the generalizability of the results, since some products are often sold in specific time periods or are more affected by the last years economic downturn, affecting the consumer behavior differently. The variable month, which is a categorical variable that indicates the month of reselling the good, will be included in the regression to reduce potential seasonal biases. There is also always a risk of confounding variables, variables that can affect the results but cannot be controlled. In this case, examining previous research, possible confounding variables could be marketing variables, such as sales, deals, promotions, and clearance, that affect the retention of the economic value of a product. However, it still captures the WTP of the consumer because if a good is not sold before it receives a price reduction, it could be an indication of the true demand of the consumer. Trends and product appearance, such as material, could also be a confounding factor that affects the retention of the value of the products, as unwanted colour of products or untrendy factors will also affect the value more than just being a reused product, which is difficult to control for in this case.

The last limitation that we discuss is the external validity. Case studies can sometimes have a very limited generalization and, therefore, limited external validity to other contexts or

geographical areas. Since the study focuses primarily on product categories and their retention of value, and not firm operations, it is possible that there will be quite a good broader applicability of this study, as other similar firms are handling the same type of product categories, creating interesting insights for other firms and policy makers. The study also relates to previous research and economic theories that cover a more generalized perspective, contributing to the external validity of this study.

4.2.3 Variable description

The variables to be used in the regressions are listed below. The empirical analysis will focus primarily on product value retention between product categories and selected retailers to broaden the view of the product category, while controlling for other potentially influential factors. In the second part, the analysis will focus on stock turnover, serving as a proxy for consumer demand, and to capture the external perspective on economic value retention. Control variables are selected based on previous research findings and their relevance to both dependent and independent variables.

Variable	**Notation**	**Measurement & description**
Dependent variables		
Product value retention	log_value_retention_perc	The retention of economic value of a sold product. The resell price is a fraction of the original price, minus the handling cost. Logged percentage variable.
Stock duration	log_stock_time	The number of days in stock from the time the product was registered until it was sold. Logged discrete variable.
Independent variables		
Product categories	dummy_leisure dummy_home dummy_electronics dummy_mobiles	Dummy variables indicating whether the product belongs to the group or not (1,0).
Retailers	Retailer_(IT) retailer_(F)	Dummy variables indicating whether the product belongs to the group or not (1,0).
Control variables		
Quantity	dummy_quantity	Dummy variable indicating whether the quantity of a product is below or above 10. (< 10 = 1, >10 = 0)
Condition of the product	condition_scale	The condition of the product on the scale New-F, classified into 1-7 starting with 1=New.

Sales channel	dummy_RH dummy_RHonline dummy_tradera	Dummy variable indicating the order channel for each sold product. (1,0)
Cost of handling	log_handling_cost_unit	The cost of handling and repairing the product. Logged discrete variable.
Original price level	original_price_level	The original price of the products divided into a categorical variable describing three different price levels, where 1: 0-500kr, 2: 501-2000kr, 3:>2000kr.
Resell price level	Resell_price_level	The resell price of the products divided into a categorical variable describing three different price levels, where 1: 0-500kr, 2: 501-2000kr, 3:>2000kr.

Table 4. Description of variables in the data set

4.2.4 Descriptive statistics

The descriptive statistics of all variables in the data set are elaborated on in Table 5. It can also be seen in what form the variables are used in and if the variables are logarithmically transformed with the natural logarithm to deal with skewness or other distributional issues. A closer observation of the categorical dependent variables will be shown later in the descriptive statistics to be able to discuss any imbalance issues and the distribution of the observations across categories and groups. The number of observations is the same across all models, representing a sample of all GIAB products.

Table 5. Descriptive statistics of variables.

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Ln (value retention)	1659	-1.846	1.334	-10.853	2.188	-1.054	5.403
Ln (stock duration)	1659	3.236	1.332	-9.21	5.964	-3.334	33.293
Home electronics	1659	.313	.464	0	1	.804	1.647
Home & interiors	1659	.319	.466	0	1	.777	1.604
Hobby & leisure	1659	.068	.252	0	1	3.428	12.755
Mobiles & accessories	1659	.047	.212	0	1	4.28	19.319
Retailer (IT)	1659	.453	.498	0	1	.188	1.035
Retailer (F)	1659	.199	.399	0	1	1.509	3.276
Condition	1659	1.912	1.339	1	7	1.575	5.042
Quantity	1659	.987	.112	0	1	-8.719	77.013
Month sold	1659	4.005	3.414	1	12	1.408	3.464
Ln (Handling cost)	1659	.258	4.421	-9.21	5.704	-1.468	3.69
Original price level	1659	2.02	.747	1	3	-.032	1.795
Resell price level	1659	1.363	.587	1	3	1.385	3.877
Returhuset in-store	1659	.043	.202	0	1	4.518	21.411
Returhuset online	1659	.112	.315	0	1	2.468	7.093
Tradera	1659	.791	.407	0	1	-1.43	3.045

The value retention variable is based on the original price, resell price, and handling cost, and to deal with the possible multicollinearity of including these in the regression, the original variables have been transformed. To ensure that there will be no multicollinearity in the regression of value retention, as well as to be able to examine the relationship between the price variables and the cost of handling, to provide the discussion of economic value retention and profitability with some statistical information, a correlation matrix of the mentioned variables is included to be able to discuss the direction of their correlations. Variables that indicate perfect correlation have a value of -1 or 1, which is usually a problem if the predictor variables are correlated with each other. As seen in the correlation matrix in Table 6, there are no correlations close to -1 or 1, indicating any problems with multicollinearity. A VIF test has also been performed for all regressions to rule out any possibility of multicollinearity.

Table 6. Correlation matrix for value retention variables.

Variables	(1)	(2)	(3)	(4)
(1) Value retention	1.000			
(2) Resell price level	0.467	1.000		
(3) Original price level	0.017	0.493	1.000	
(4) Handling cost	-0.123	-0.142	-0.034	1.000

As seen in the summary table of descriptive statistics, there are many imbalances in the categorical variables, indicating that the distributions of the groups are quite uneven. To be able

to discuss this and bear this in mind through the empirical analysis, some tables on the distributions of the categorical variables will be provided for selected variables of importance for this study. Starting with the product categories used as an explanatory variable in this sample, the following distribution of the observations can be seen, indicating two larger groups followed by two smaller ones, which needs to be considered.

Table 7. The number of observations in each category of products in the data set.

Mobiles & accessories	89
Home electronics	520
Hobby & leisure	113
Home & interior	529
Other	*408*

Two different retailers will also be used in the analysis to see how products categorized by retailers behave compared to categorized by product characteristics, this can give interesting insights into what matters and if there is anything that needs further investigation. The chosen retailers represent different types of products to include a wider perspective on the retention of value, as well as on consumer preferences. The retailers will also be presented with some additional information about their businesses and what types of products they provide GIAB with.

Table 8. Description of the retailers sampled.

Retailer (IT)	Online IT reseller of mobile phones, computers, monitors, audio, video, tablets**,** and networks. Sells products from high-quality familiar IT-manufacturers.	752
Retailer (F)	Furniture, interior, garden furniture, and other household items. Sells furniture online and in homeware stores through retailers, their own brand.	330
Other		*577*

Table 9. GIAB's sales channels.

Tradera	1,312
Returhuset in-store	71
Returhuset online	185
Other	*91*

Table 10. The products and their condition classification.

New – Factory new	954
A - Perfect condition	274
B - Good condition	217
C – Good condition	101
D – Acceptable condition	84
E – Imperfect condition	8
F – Salvage	21

Finally, the distribution of the sales channels and the product conditions used by GIAB is visualized in the two tables above, where the largest share of products are in the highest condition, and most of the products in this sample are sold on the auction side Tradera, which will be discussed further in the discussion.

4.3 Method

The methodology used in this study is an econometric method, specifically ordinary least squares (OLS) multiple regression, applied to two distinct outcome variables. Several independent variables are considered, along with controls for possible confounders. The decision to use a linear regression model was based on the distribution and characteristics of the variables, making linear regression the most suitable approach. Linear regressions are commonly applied in the analysis of sales data and marketing mix models due to their efficiency in estimating associations between variables.

The assumptions underlying the OLS regression have been rigorously tested, and any deviations are addressed. Robust standard errors are incorporated into the regressions to account for the possibility of heteroskedasticity. However, it is essential to acknowledge that while these assumptions are examined, multiple OLS regressions may still encounter limitations in precisely estimating the relationships between variables. Statistical modelling is inherently an approximation of real-life data distribution. Furthermore, it is crucial to interpret the results with caution understanding that regression analysis can identify associations but cannot establish causality. Confounding variables and omitted variable bias may influence the interpretation, even when controlled.

4.4 Regression Models

The empirical analysis will be divided into two sections. The first section will analyze potential profitability through value retention across product categories, as well as across two retailers. The second section will focus on a proxy for consumer preferences, examining the effects on stock turnover from the same independent variables, thus providing a second perspective to the analysis.

4.4.1 Section 1: Value retention

This analysis aims to determine whether certain product categories or specific retailers yield higher value retention, while keeping other possible effects constant in a multiple linear regression using OLS. Although product categories are broad, they can still provide insight into whether different categories of products retain value differently. This analysis is valuable for firms to understand the variations between types of goods and to tailor their resale focus accordingly. The retailer analysis can provide information on the differences that can arise between reselling different types of goods in relation to where they come from and whether their well-known brands.

In this part, the retention of product value will serve as the outcome variable, while dummy variables representing the product categories and retailers will serve as the explanatory variables, forming a linear regression for the categories. The model will also control for condition, quantity, month of resale, original price category, resell price, and cost spent handling the product as well as resell channels. Since product value retention is calculated

based on the original and resold prices, along with additional handling costs, the price variables are included as dummies to avoid introducing multicollinearity into the model while still controlling for unwanted price effects.

The first model, A, with the outcome variable product retention and the effect of product categories, will be used as four different regressions, one for each product category. Model A will be outlined as follows:

Equation 1. Model A, Product value retention across product categories.

$$\begin{aligned}\text{log\_value\_retention\_perc} &= \beta 0 + \beta 1\text{product\_category} + \beta 2\text{condition\_scale} + \beta 3\text{dummy\_quantity} \\ &+ \beta 4\text{month\_sold} + \beta 5\text{log\_handling\_cost} + \beta 6\text{resell\_price\_level} \\ &+ \beta 7\text{original\_price\_level} + \beta 8\text{dummy\_RH} + \beta 9\text{dummy\_RHonline} \\ &+ \beta 10\text{dummy\_tradera} + \epsilon\end{aligned}$$

Here, product_category will be replaced with the specific dummy for the given category of mobiles & accessories, home electronics, home & interior, and hobby & leisure. In all models, $\beta 1$ will be the coefficient for the independent (explanatory) variable and where $\beta 2 - \beta 10$ are the coefficients estimated for the control variables. Robust standard errors are also included.

The second model, B, will be used with the same outcome variable as in model A, but instead with the two different retailers as two separate regressions presented in the same table for comparison.

Equation 2. Model B, retention of value of products among retailers.

$$\begin{aligned}\text{log\_value\_retention\_perc} &= \beta 0 + \beta 1\text{retailer} + \beta 2\text{condition\_scale} + \beta 3\text{dummy\_quantity} \\ &+ \beta 4\text{month\_sold} + \beta 5\text{log\_handling\_cost} + \beta 6\text{resell\_price\_level} \\ &+ \beta 7\text{original\_price\_level} + \beta 8\text{dummy\_RH} + \beta 9\text{dummy\_RHonline} \\ &+ \beta 10\text{dummy\_tradera} + \epsilon\end{aligned}$$

Where *retailer* will be replaced with the specific dummy of the given retailer of Retailer (D) and Retailer (HF).

4.4.2 Section 2: Consumer preferences – stock turnover

In the second part of the empirical analysis, the regression will delve into the stock turnover, employing a more external perspective to be able to discuss the consumer preferences, which in the literature review is stated to be important to understand when discussing the creation of economic value. In this section, the same independent variables will be used, but the outcome variable will instead be the natural logarithm of the number of days in stock for each product. This outcome variable will serve as an indication of consumer demand or preferences, allowing this study to incorporate the consumer perspective into the analysis and discuss its relationship with Models A and B regarding value retention. Apart from the outcome variable, the same explanatory and control variables will be included in these models to be able to compare and discuss the results, which are based on the same sample.

The first model in this section will be structured similarly to A, but instead the duration of the stock will serve as the outcome variable. Model C can be illustrated as follows:

Equation 3. Model C, stock duration in product categories.

$$\begin{aligned}\text{log\_stock\_time} &= \beta 0 + \beta 1\text{product\_category} + \beta 2\text{condition\_scale} + \beta 3\text{dummy\_quantity} \\ &+ \beta 4\text{month\_sold} + \beta 5\text{log\_handling\_cost} + \beta 6\text{resell\_price\_level} \\ &+ \beta 7\text{original\_price\_level} + \beta 8\text{dummy\_RH} + \beta 9\text{dummy\_RHonline} \\ &+ \beta 10\text{dummy\_tradera} + \epsilon\end{aligned}$$

Model D is similar to Model B, but with the outcome variable of stock duration instead of retention.

Equation 4. Model D, stock duration between retailers.

$$\begin{aligned}\text{log\_stock\_time} &= \beta 0 + \beta 1\text{retailer} + \beta 2\text{condition\_scale} + \beta 3\text{dummy\_quantity} \\ &+ \beta 4\text{month\_sold} + \beta 5\text{log\_handling\_cost} + \beta 6\text{resell\_price\_level} \\ &+ \beta 7\text{original\_price\_level} + \beta 8\text{dummy\_RH} + \beta 9\text{dummy\_RHonline} \\ &+ \beta 10\text{dummy\_tradera} + \epsilon\end{aligned}$$

The four different models will be visualised in one table each in the empirical analysis, where each explanatory dummy variable will have its own column in each of the tables, to provide a good overview of the results, as well as an easier interpretation and analysis.

5. Empirical Analysis

5.1 Section 1: Product Value Retention

Table 11. Model A: Retention of product value across product categories.

	(A1)	(A2)	(A3)	(A4)
Home electronics	**-.029**			
	(.068)			
Mobiles & accessories		**-.872*** **		
		(.114)		
Home & interior			**.248*** **	
			(.066)	
Hobby & leisure				**.658*** **
				(.093)
Product condition	-.026	-.038*	-.024	-.034
	(.023)	(.022)	(.023)	(.022)
Quantity	-.806**	-.769**	-.8**	-.499
	(.358)	(.333)	(.364)	(.333)
Month sold	.03***	.026***	.029***	.032***
	(.007)	(.007)	(.007)	(.007)
Cost of handling	-.01	-.01	-.011*	-.008
	(.007)	(.006)	(.006)	(.006)
Resell price level	1.015***	1.028***	1.04***	.983***
	(.057)	(.056)	(.058)	(.056)
Original price level	-.428***	-.466***	-.49***	-.427***
	(.048)	(.049)	(.052)	(.048)
Returhuset in-store	-.662***	-.662***	-.761***	-.699***
	(.137)	(.131)	(.137)	(.131)
Returhuset online	-.01	-.031	.013	-.006
	(.083)	(.082)	(.084)	(.082)
Tradera	-.806***	-.798***	-.85***	-.854***
	(.094)	(.092)	(.094)	(.09)
Cons.	-.961***	-.871**	-.927**	-1.229***
	(.372)	(.344)	(.378)	(.342)
Observations	1659	1659	1659	1659
R-squared	.326	.344	.332	.34

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1

The general fit of model A is sufficient with an R-square value between 32-34%, which is considered acceptable with respect to the proportion of the variance explained by the chosen model. The number of observations is the same in all given regressions, and the overall significant levels show some indication of correlations. Since the outcome variable, the retention value, is a percentage variable transformed to the natural logarithm, the coefficients are quite difficult to interpret in terms of understanding the percentage change. Therefore, the explanatory variables of both models A and B are transformed with the natural logarithm to prove an easier interpretation. The controls will not be transformed since the discussion of them will only include the direction of the coefficients and the relations between the variables, not the specific numbers obtained. The transforming formula used is: $\left(e^{\beta}-1\right)\times 100 =$

$Percentage\ Change$, and the results for the explanatory coefficients are presented in the following table.

Table 12. Transformed coefficients of the table 10 product categories.

Home electronics	$(e^{-0.29} - 1) \times 100$	≈ -25.11
Mobiles & accessories	$(e^{-0.872} - 1) \times 100$	**≈ -58.24 *** **
Home & interior	$(e^{0.248} - 1) \times 100$	**≈ 28.17 *** **
Hobby & leisure	$(e^{0.658} - 1) \times 100$	**≈ 93.27 *** **

Three out of the four product categories indicate significant values at the 1% level, where mobiles and accessories indicate a 58.24% decrease in value retention compared to other products in the sample, keeping all other affects constant. Both home and interior, as well as hobby and leisure, can be associated with a higher value retention compared to other products where the highest increase in value retention, with 93.27% is hobby and leisure, compared to the reference groups. The effect of home electronics is statistically insignificant.

Briefly, going over the controls, the product condition has negative coefficients for all product categories, although only displaying a significant value on the 10% level for home electronics, indicating that a one-unit worse condition on the scale gives a decrease in the retention, holding all other factors constant. Some other interesting controls are the resell price level and the original price level, indicating for all coefficients an increase in the value retention of a higher resell price and a decrease in the value retention of a higher original price level. The negative effect of selling the goods at Tradera on the value retention is greater compared to selling the goods in-store or online, although the coefficients for online are insignificant, which could be due to the imbalance in the categories. The cost of handling has only a significant effect on the home and interior of the model, indicating a decrease in value retention when increasing the cost of handling, although it is quite a small effect.

Table 13. Model B: Retention of product value among retailers.

	(B1)	(B2)
Retailer (IT)	**-.423*** **	
	(.063)	
Retailer (F)		**.418*** **
		(.068)
Product condition	-.06***	-.021
	(.022)	(.023)
Quantity	-.543	-.82**
	(.352)	(.357)
Month sold	.033***	.035***
	(.007)	(.007)
Cost of handling	-.005	-.01
	(.006)	(.006)
Resell price level	1.018***	1.061***
	(.057)	(.057)
Original price level	-.551***	-.515***
	(.05)	(.05)
Returhuset in-store	-.794***	-.855***
	(.135)	(.141)
Returhuset online	-.008	-.014
	(.09)	(.084)
Tradera	-.899***	-.87***
	(.1)	(.093)
Cons.	-.662*	-.895**
	(.362)	(.37)
Observations	1659	1659
R-squared	.342	.338

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*

Retailer (IT)	$(e^{-0.423} - 1) \times 100$	**≈ -34.54 *** **
Retailer (F)	$(e^{0.418} - 1) \times 100$	**≈ 51.87 *** **

Table 14. Back-transformed coefficients of Table 11 retailers.

In Model B, the same outcome variable is used, but instead the products are sorted by the retailer, providing the analysis with a different perspective. The overall fit of the model is sufficient, and the two explanatory variables are significant at the 1% level with their back-transformed variables shown in the Table 14 above. The products of the retailer (IT), that is, the IT products and electronics, are associated with a decrease in the retention value of 34.52% compared to other products, holding all other factors constant. For the retailer (F) with its focus on home and interiors, which provides mainly furniture, the coefficient indicates an increase in value retention compared to other products, holding all other factors constant. Looking briefly over the controls, the product condition has a significant decrease associated with the retailer (IT), and the price levels of both resell and original price behave similarly as in model A, as do the order channels, not providing any disparate associations.

5.2 Section 2: Stock Turnover

In this section, the value retention is exchanged with the variable indicating the stock turnover, which is a logged variable over the days in stock, providing a percentage change when interpreting the coefficients of interest. Furthermore, except for the exchange of the outcome variable, all explanatory and control variables remain the same. The R-squared, is slightly lower in these two regressions, indicating that confounding factors might affect the results.

Table 15. Model C: Stock duration across product categories.

	(C1)	(C2)	(C3)	(C4)
Home electronics	**-.145****			
	(.067)			
Mobiles & accessories		**.518*****		
		(.109)		
Home & interior			**-.166*****	
			(.056)	
Hobby & leisure				**0**
				(.111)
Product condition	-.022	-.02	-.028	-.027
	(.023)	(.023)	(.023)	(.023)
Quantity	-.927***	-.966***	-.948***	-.942***
	(.274)	(.283)	(.28)	(.283)
Month sold	-.008	-.004	-.006	-.007
	(.011)	(.011)	(.011)	(.011)
Cost of handling	.05***	.053***	.054***	.053***
	(.008)	(.008)	(.008)	(.008)
Resell price level	.228***	.215***	.206***	.224***
	(.077)	(.077)	(.077)	(.077)
Original price level	-.433***	-.409***	-.39***	-.431***
	(.046)	(.046)	(.047)	(.046)
Returhuset in-store	.537**	.625**	.693***	.616**
	(.267)	(.267)	(.265)	(.266)
Returhuset online	.014	.01	-.018	-.001
	(.24)	(.242)	(.242)	(.241)
Tradera	.719***	.771***	.806***	.77***
	(.161)	(.164)	(.163)	(.163)
Cons.	4.231***	4.101***	4.13***	4.162***
	(.314)	(.323)	(.32)	(.321)
Observations	1659	1659	1659	1659
R-squared	.145	.149	.145	.143

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*

Examining the explanatory variables, two of them can be associated with statistical significance on the 1% level and one on the 5% level, two indicating decreases, and one indicating an increase in stock duration. Home electronics can be associated with a 14.5% shorter stock duration compared to other goods, and similarly home and interiors, also indicating a 16.6% decrease in stock duration compared to other product categories, while keeping all other effects constant. The mobile and accessories coefficient is associated with a 51.8% longer stock time, compared to the reference group. Briefly, going over the significant control variables of interest, the resell price level indicates that a one-unit higher price level increases the stock duration by around 22% for all categories, while the original price level coefficient indicates

an around 40% decrease in stock time for a one-unit increase in the price level group. For all categories, the stock time in-store is a bit shorter compared to the stock time at Tradera, and a lower quantity (below 10) indicates, for all product categories, a decrease in the stock time, which is reasonable.

Table 16. Model D: Stock duration across retailers.

	(D1)	**(D2)**
Retailer (IT)	**.465*** **	
	(.08)	
Retailer (F)		**-.397*** **
		(.055)
Product condition	.01	-.032
	(.024)	(.023)
Quantity	-1.234***	-.932***
	(.294)	(.275)
Month sold	-.01	-.011
	(.011)	(.011)
Cost of handling	.049***	.053***
	(.008)	(.008)
Resell price level	.219***	.179**
	(.077)	(.076)
Original price level	-.296***	-.348***
	(.052)	(.047)
Returhuset in-store	.778***	.814***
	(.264)	(.267)
Returhuset online	-.006	0
	(.242)	(.241)
Tradera	.883***	.841***
	(.167)	(.164)
Cons.	3.819***	4.086***
	(.336)	(.315)
Observations	1659	1659
R-squared	.163	.154

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*

In the last regression, both retailers can be associated with statistically significant coefficients at the 1% level, where retailer (IT) has an increased stock time with 46.5% compared to retailer (F), whose products have a decreased stock time, by 39.7% compared to other products, while keeping all other factors constant. The control variables in this regression do not show too much variance across product categories, similar to Model C, indicating more general factors than product-specific ones. The results will be elaborated on and discussed in relation to previous research and theoretical frameworks in Section 6.

6. Discussion

The primary objective of this study is to analyse the creation of economic value within the Product Life Extension (PLE) business model and to identify specific product categories and characteristics that influence the retention of value in reuse loops, consequently impacting the revenue streams of PLE firms. The empirical analysis focused on Godsinlösen AB as a case study, using their sales data to gain insight into product categories and where they come from and their retention of value, as well as consumer preferences regarding the characteristics and attributes of reused goods. In this section, the main findings of the empirical analysis will be discussed, interpreted, and compared in relation to previous research and theoretical frameworks.

6.1 Economic Value Retention

According to Lacy and Rutqvist (2015), the characteristics of products that are important when reusing products are durability, quality, and functionality because the economic value tends to remain higher. There is also a great deal of focus on product design, indicating that some product designs hinder reuse, both through technical aspects and through their appearance. The design and durability of the product are not included in this analysis, but looking at the quality and functionality could give indications of how it affects the retention of different types of product's economic value. Starting with the category of products, looking at the descriptive statistics, it can be seen that the majority of the products in the sample belong to the groups home electronics *(520)* and home and interior (529*)* in Table 7*,* and looking at the condition of the products in Table 10, more than 50% of the products are factory new, followed by a biased distribution in condition from A (perfect condition) to D (acceptable condition), where the number of observations decreased with the worse condition and where only a few products are in imperfect and salvage condition. Here, it can be stated that half of the products being resold by GIAB are new products, most likely unused returned items, or old collections or residual stock, for some reason not being sold by their original manufacturer or retailer.

Starting with the correlation matrix in Table 6, of the variables used to calculate value retention, it can be seen that both the original price level and the resell price level indicate a positive correlation with value retention, indicating that more expensive products have higher value retention. The correlation of handling cost with value retention is negative, which is not very surprising. The resell price level and the original price level also have a positive correlation, and one would expect that the resell price somewhat follows the original price.

Moving to model A in Table 11 as well as the back-transformed coefficients in Table 12, mobiles and accessories are associated with a 58.24% lower retention of value compared to other products and where home and interiors, as well as hobby and leisure, are associated with a 28.17% respectively 93.27% higher retention of value than other products in the sample, holding all other factors constant. But since the sample is somewhat unbalanced and where most products belong to two larger categories, the next model, B in Table 11, can shed some

light on a different perspective where the products instead are categorised by what retailer they come from, one being focused on IT and the other one being focused on furniture and interiors. The retailer that provides GIAB with IT and electronics has a decrease of 34.54% associated with value retention, while the second retailer has an increase of 51.87% in value retention compared to other products, keeping all factors constant. The most interesting result that arises here is that mobiles, electronics and IT seem to be associated with a lower value retention compared to other goods, across both models, while the home and interior, including some furniture as well, are associated with a higher value retention compared to the reference groups.

The WTP of the consumer seems to be lower with regard to IT and electronics, compared to their original price, now being resold. Bakker et al. (2014) pinpointed that small electronics lose their value rapidly due to both planned obsolescence and market competition and customer preferences, which might be a reason for the indication of a quite drastic negative effect on the PRV for IT and electronics because the market accelerating rapidly, making a lot of products almost useless after a while, with a low demand and a need to lower the resell price accordingly. According to Xing and Luong (2009), IT and electronics, such as computers, mobile phones, and cameras, are usually older than other goods, due to trends rather than outdated functionality or technology, because appearing to customers is no longer preferred. Reselling goods that go obsolete fast, regardless of functionality or technology, will have a lower demand, and subsequently a lower consumer WTP. When the goods are in sufficiently good condition and not in need of any repair or refurbishment, it is also hard to add value or update the product through add-ons to add value through interaction when the given appearances are not valuable enough, which is discussed by Bakker et al. (2014) and Whalen (2020) in the product interaction scale and value-adding activities throughout the business model.

Regarding home and interiors, as well as hobby and leisure, including furniture, interiors, and some garden furniture, these product categories appear to retain their value better than other products, which is indicated in both models A and B. Although furniture and interiors are somewhat tied up to trends, as Lacy and Rutqvist (2015) mention, it is also a lower paced market compared to IT and electronics, which could be an indication that the retention of value declines much slower, and as long as the products retain their functionality and are not too specific in style, their value will decrease in a slower rate than previously mentioned IT and electronics. When the market is not moving forward at the same pace, there is also a higher incentive to design products that are more durable, being able to charge a higher price, instead of focusing on volume, where the materials used in furniture and interiors are often more durable with no planned obsolescence. The functionality of a product is often desired in the PLE business model according to Lacy and Rutqvist (2015), the basic functionality of furniture does not change significantly over time. A chair, table, or sofa performs the same function regardless of its age. However, electronics become less functional as software updates cease, components wear out, and compatibility with newer technology decreases, affecting the retention rate. In general, there is a steady demand for well-made and reused furniture because it can be significantly cheaper than new high-quality pieces while still offering durability and style. The market for used electronics is more volatile and tends to be driven by the need for the latest technology, which quickly depreciates as newer models are introduced.

6.2 Stock Time Duration

In the second part of the empirical analysis, the retention of the value of products was replaced with stock turnover, to include an external perspective, which can be a proxy of consumer preferences regarding reused goods. Starting with the summary statistics, unlogging the mean of the outcome variable time in stock, indicating the days in stock, the mean of days for a product is 25 days. Included in this is the handling before the products are sold, and some products sold through auction sites might have a generally longer stock duration due to the format of the auction.

Starting with model C in Table 15, it is indicated in the sample that home electronics, as well as home and interiors, have a stock duration of around 15% shorter compared to other product categories and where mobiles and accessories are associated with a stock duration of almost 52% longer compared to other product categories, keeping all other factors constant. In model D, which focuses on one IT retailer and one furniture and interior retailer, the coefficients of the explanatory variables indicate that IT and electronics products have a 46.5% longer stock duration compared to other goods, while the products of retailer (F) indicate a 39.7% shorter stock duration, holding all factors constant. Studying the control variables of the original and resell price levels, in model C, a higher level of resell price level indicates around 20% longer stock duration for all product categories, and where a higher level of original price level indicates around 40% shorter stock duration, highlighting the complexity between consumers wanting to buy higher-priced, maybe higher quality items, but at a lower price, wanting to make a bargain. The same direction can be seen in model D, indicating, for retailer (IT), a 22% longer stock time for a one-unit higher resell price, while a one-unit higher original price indicates an almost 30% decrease in stock time. For retailer (F), a higher original price level indicates an almost 35% shorter stock duration, and where a one-unit higher resell price level indicates an increased stock with 18%.

The interplay between original and resale prices underscores the complexity of consumer preferences and behaviour, demanding high-quality (more expensive) products at lower prices. This interaction, as discussed by Jimenez-Parra et al. (2014) in the TPB model, highlights the importance of cost savings and perceived quality in influencing consumer attitudes and motivations toward purchasing reused products, hence affecting their WTP. Firm strategies must consider these dynamics, recognising the impact of price, reputation, market pace, and brand on consumer purchasing decisions across different product categories. Since both furniture and IT can be seen as more inferior goods, although depending on specific brands, the relation between the original price and resell price, hence affecting stock duration, can be seen as a price elasticity where the price reduction can have a positive effect on the price elasticity where consumers, who generally are more sensitive, now have a higher preference for buying the good if the price is affordable. As discussed in the value retention, products seen as durable or having a longer product life time will also affect the consumer WTP as well as their price sensitivity where products indicating longer stock times can have a negative effect on the price elasticity because a more volatile market, which could be the case for IT and electronics, making the consumer more hesitant when deciding to purchase. Consumers are

often highly price sensitive regarding electronics. The rapid depreciation of electronics means that buyers expect significant discounts on second-hand items because of a saturated market, where many products depreciate fast. Sellers may hold out for better prices, leading to longer stock durations as they wait for consumers willing to pay the asked price.

The condition and performance of used electronics can vary significantly. Potential buyers may be concerned about battery life, potential wear and tear, and the remaining lifetime of the components. This uncertainty can make them reluctant to purchase used electronics, leading to longer stock times, which is highlighted by Kwarteng et al. (2018) as well as Pretner et al. (2021) discussing the factors that affect consumer WTP. During economic downturns or periods of financial uncertainty, consumers can cut back on discretionary spending, particularly on items such as electronics that are considered nonessential. This reduced willingness to pay can lengthen the time electronics used remain in stock. On the contrary, furniture often retains its utility and appeal regardless of age, and consumers are generally more willing to buy reused furniture due to its longer lifespan, potential for customisation, and the ability to fit various aesthetic preferences. Therefore, while used furniture also faces some challenges in resale, it tends to move more quickly compared to electronics.

6.3 Creation of Economic Value in a PLE Business Model

To conclude the discussion of this study, this final section will highlight the possibilities and challenges discovered in creating economic value within the PLE business model, examining how they relate to the case firm and specific product categories, while discussing previous research. As highlighted by the SMB framework by Bocken and Short (2016) and the interaction scale by Whalen (2020), participating in activities and interactions with products can potentially enhance or maintain their value, even if the firm is not the original manufacturer. The regression analyses and statistical examinations reveal that many products are in good condition, suggesting that adding value and generating economic surpluses may be challenging due to consumer preferences for purchasing reused goods, particularly those originally deemed durable but now available at lower prices. Consequently, if there is limited demand for a new product, its resale price must be reduced to attract buyers, resulting in diminished value retention, especially for products such as electronics with faster-paced markets.

Products in slower markets that retain their initial functionality longer appear to be easier to resell, especially if the price trade-off is favourable, potentially enabling greater retention. However, given GIAB's collaboration with diverse companies across various sectors, uncertainties and obstacles within the value chain can affect value generation. As discussed by Vermunt et al. (2019), uncertain product flows can require advanced technological skills and effective marketing strategies, posing challenges in reaching desired customer segments instantly and potentially lacking the necessary internal expertise to manage a wide range of products. Further analysis is required to understand why certain products remain in stock longer; the original demand for a product may influence its subsequent value retention, as unsought goods are inherently difficult to resell unless heavily discounted, leading to reduced revenue, which also seems to be dependent on product type.

Examining different product categories and specific retailers requires a more detailed investigation to determine which specific items retain the most value due to their characteristics and market composition in more detail. Following the suggestion of the TBA model, companies adopting a PLE business model must closely examine products and their respective consumer preferences with respect to brands and conditions to be able to know if it is a reuse deal profitable or not. This analysis shows the indication of the categories and products that indicate a higher retention of value and consumer demand, while controlling for important factors that affect the reuse deal. These results can be used in more general terms for firms to investigate their strategies more closely, to determine consumers' willingness to pay (WTP), and implement appropriate strategies, both internally and externally, encompassing both soft and hard attributes, to maximise economic and product interaction value through reuse.

7. Conclusion

Through an explorative case study of the circular firm Godsinlösen AB, this analysis of economic value retention and stock duration within the Product Life Extension (PLE) business model highlights how specific product categories and characteristics may influence the retention of economic value, thereby impacting the revenue streams of PLE firms. The study identifies several themes that affect value retention and stock turnover for a product, such as: durability, quality, and function, product design and planned obsolescence, the interaction between original price and resale price, and market dynamics. These themes are also influenced by external consumer preferences and behaviours, making it a complex balance act between all interests.

Since consumers tend to have a higher willingness to pay (WTP) and seem to be less sensitive to products with longer durability, the initial design of the product is crucial for the possibility of reuse. A more sustainable and durable initial design can affect the embedded value throughout the product's lifetime. This aspect is targeted by many initiatives and regulations for a circular economy, particularly the Circular Economy Action Plan, which focuses on product design and reparability, aspects this study relates to. Until these regulations are fully implemented, profitable gap-exploiting firms within the PLE business model must strategically target and map out products that can either have value added through activities and interactions or those that retain a higher embedded value over time due to their characteristics and initial design. Reselling goods that do not retain value over time will favour linear firms more than circular ones.

In conclusion, the empirical analysis of Godsinlösen AB's sales data underscores the importance of product characteristics and consumer preferences in influencing economic value retention and stock turnover within the PLE business model, thus affecting revenue streams. By strategically managing product selection in categories, pricing, and marketing, PLE firms can improve their revenue streams and achieve sustainable business growth.

Despite the interesting results for the PLE model and the product categories and characteristics in the empirical analysis, there are still limitations and weaknesses to address, particularly in the given data set. Therefore, further research should analyze data from multiple time periods to capture changes over time, ideally through panel data or time series data from different entities to achieve broader and more generalizable results. The current data set could also be used for more detailed research, such as creating new interaction variables or studying specific products, materials, or subcategories and their relationship with other variables, creating new perspectives for this specific type of business model. Finally, this type of research can provide a deeper understanding of the market characteristics of different types of products and consumer motivations to purchase reused goods in the given area.

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