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The long-run returns of structured investment products

Finnish evidence

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ABSTRACT:

Most studies state that investing in structured investment products (SIPs) is irrational. This irrationality is due to research findings showing that SIPs favor the issuer and are overpriced. This overpricing is especially emphasized in the primary market. According to Grünbichler and Wohlwend (2005), capital-protected SIPs are well above their theoretical values at the time of issue. Despite regular criticism among academics, the popularity of SIPs has remained relatively strong. The thesis comprehensively examines the theory of capital-protected SIPs and attempts to provide knowledge to see if these products are good alternative investment vehicles.

According to traditional theories, investors do not make mistakes. The best performance is achieved by owning a sufficiently diversified portfolio, which leads to the highest return relative to the risks. However, numerous anomalies that differ from the market efficiency have been identified. The existence of such anomalies is difficult to explain by the efficient market hypothesis (EMH) since it does not respect the limits of rational decision-making. In addition to traditional theories (e.g., Markowitz, 1952; Fama, 1970), factors related to investor psychology and behavior should be considered. The inability of efficient markets to explain the challenges facing the investment world has led to the growing importance of behavioral theories.

Capital-protected products fit into the frameworks of behavioral theories, as these products are much more effective than many other investment instruments in avoiding downside risk. The investing behavior of investors can be explained by the value function of the prospect theory developed by Tversky and Kahneman (1979). Based on this non-linear value function, some SIPs optimize the subjectively perceived utility of the investor. Therefore, it is possible that human psychological preferences—reflecting prospect theory, mental accounting, loss aversion, and other investor psychological factors—influence investors' attitudes towards risks and investments.

The thesis focuses on typical, capital-protected SIPs with a potential return linked to the performance of an index. The study investigates the performance of capital-protected SIPs issued and expired in Finland during 2010–2019, and compares these products to another form of passive investing—index investing. By empirically examining the returns of such products, the quantitative research of the thesis seeks to produce a more comprehensive understanding of the Finnish markets of capital-protected SIPs.

KEYWORDS: structured investment products, capital protection, passive investing

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Abbreviations

AR	abnormal return
BSM	Black–Scholes–Merton option pricing model
CAPM	capital asset pricing model
CAR	cumulative abnormal return
CF	cash flow
EMH	efficient market hypothesis
FV	face value
HPR	holding period return
NII	net interest income
PV	present value
SIP	structured investment product
TRI	total return index
WR	wealth relative
ZCB	zero-coupon bond
YTM	yield to maturity

1 Introduction

As reported by Yen and Lai (2014, pp. 2–4), a *structured investment product* (SIP) is, by definition, a combination of two or more instruments whose return is determined based on a performance of the underlying asset. The popularity of these products has remained relatively strong despite regular criticism (Grünbichler & Wohlwend, 2005). The thesis comprehensively explores the theory of SIPs and attempts to answer the question of whether to buy these products or not.

1.1 Structured investment products (SIPs)

It is essential to be clear about the definition of SIPs. According to Das (2005), SIPs are bond-style financial instruments that enable the investor to benefit from favorable market developments. SIPs can be customized based on the interest rate, maturity, underlying asset, level of *capital protection*, and risk level (Yen & Lai, 2014, p. 2–4).

As stated by Das (2005), SIPs are fixed-income investments that allow an investor to invest in underlying assets that may otherwise be too expensive or even impossible to reach. SIPs also meet the diverse needs of different types of investors as they can build a myriad of different return and risk profiles (Järvinen & Parviainen, 2014, p. 29).

The term capital protection refers to the capital that is protected and repaid upon maturity of the investment, regardless of the direction in which the value of the underlying asset develops. In other words, SIP that is capital-protected provides—at maturity—an amount that at least matches a given proportion of the original capital input of the investor. The part of a SIP that enables different levels of capital protection is an interest-bearing zero-coupon investment that—on the maturity date—rises to a pre-agreed level of capital protection (Järvinen & Parviainen, 2014, p. 59). Järvinen and Parviainen (2014, p. 59) reported that this feature of capital repayment has led to a term of capital protection, also known as *principal-protection*.

Schroff, Meyer, and Burghof (2015) noted that one typical way to describe the markets for SIPs is to divide them into two main categories: long-term and short-term investment products. According to Schroff et al. (2015), long-term investments have relatively conservative return and risk profiles that are similar to the underlying asset. However, return and risk profiles are somewhat more conservative. Furthermore, long term investments are typically medium to long-term strategies used by retail investors to implement their savings plans. The SIPs—that the thesis focuses on—are long-term investments. These products are also a useful way to implement savings plans, as will be discussed later in the thesis.

As stated by Schroff et al. (2015), depending on the structure, the long-term SIPs may provide investors with the opportunity to benefit from both the ups and downs of the market. Short-term products include products designed for short-term trading. They are typically more professional, more complex, and more speculative leverage trading strategies (Schroff et al., 2015).

1.2 Research problem and the purpose of the thesis

The thesis aims to investigate the ability of SIPs with full capital protection—combined with an index call option—to perform over time. Passive index investment strategies are used in comparisons. To ensure comparability, the performance of these investment strategies is compared over the same time period. The SIPs that are used in the thesis have the same return and risk profiles in order to determine whether capital-protected investment products—with the full capital protection—are acceptable alternative investment vehicles.

The *total return indices* (TRIs) of *Euro Stoxx 50*, *OMX Nordic All-Share*, and *OMX Helsinki* are used as a form of passive index investing. These TRIs have been selected to proxy market returns as the SIPs—used in this study—are allotted into three different portfolios based on the underlying index assets they contain. Based on this, the test hypothesis is formed as:

H_1: The returns on passive index investments differ from the returns on capital-protected SIPs.

Usually, the research compares passive index investing with active mutual funds or hedge funds (Wolley & Bird, 2003; Ezra & Warren, 2010). However, the thesis makes a comparison between SIPs and passive index investing.

In addition, the empirical analysis of this thesis examines the performance differences in means and medians between the different types of SIP portfolios. It is to be tested whether there are statistically significant market-adjusted return differences between the Europe and Nordic, Europe and Finland, and Nordic and Finland portfolios.

The comparisons are made for all products in the whole sample as well as for the different portfolios by using appropriate equity market indices as market benchmarks. The data and methodology chapter explains the use of the two different market-adjusted long-run methods—*abnormal returns* and *wealth relatives*. The main emphasis is on utilizing different mean and median figures in various ways.

In both market-adjusted methods, the *Student's* (1908) *t*-test is employed to determine whether the null hypothesis holds true for all the products as well as for the different product portfolios. The hypothesis is also tested with the *Wilcoxon's* (1945) *ranked-sum test* as well as with the *Wilcoxon–Mann–Whitney rank test*. In the latter, statistical equality of means and medians between the portfolios has also been tested in order to find a possible statistical performance difference between the SIPs of different underlying stock indices. All the statistical methods are further explained in more detail in Chapter 6.

1.3 Limitations and assumptions

The returns of fully capital-protected SIPs vary remarkably over time. Due to the capital protecting properties, the return performance of SIPs varies greatly as a result of the general price development of the market. For this reason, the empirical results should be interpreted with caution. The empirical section of this study shows that as the market rises, fully capital-protected SIPs tend to have considerably lower returns over that time period compared to passive index investing. This finding is consistent with other studies comparing SIPs to market returns. In contrast, SIPs can become reasonably good investment choices, for example, in the situation of crisis.

Academics have not widely examined SIPs and their performance, and the part of the methodology is still under development. Unfortunately, the limitation of the empirical part of the thesis is a small number of SIPs and the uneven distribution of product issues during the observation period. This is due to the challenging data availability, and the fact that during low interest rates, the issuance of capital-protected SIPs has decreased significantly (FSPA, 2015, 2018).

The extent and comparability of the data are critical concerns in the thesis. The gathering of the information was complicated, as it is often not in the interest of the bank to disclose such information. For example, cost information—such as hedging costs and issuance costs—of issuers is not available from any bank in Finland. Therefore, most of the requested data was not provided due to the grounds of data secrecy and scarcity.

However, data scarcity is not necessarily a bad factor. Due to the limited amount of data and research on SIPs, a relatively high contribution might be achieved. The thesis aims to contribute by examining something that has not been studied before. The quantitative research seeks to provide new information about the Finnish markets of SIPs.

In addition, other limitations have emerged due to the globally poor availability of the data. This study is limited to a small number of SIPs issued in the Finnish market. The underlying assets of these products are indices that track the stocks of European companies. For this reason, conclusions can only be drawn in terms of capital-protected European index-linked SIPs issued in Finland. Assumptions regarding the market portfolio have also been made by selecting specific TRIs to proxy stock market returns.

Because of the small sample size, the product portfolios of the thesis are unfortunately very thin. Due to this thinness, all research results should be viewed with caution. Smaller sample sizes typically have more substantial sampling errors, as a smaller sample may coincidentally deviate significantly from the population (Figlewski & Chidambaram, 1993; Poon & Granger, 2003). According to Figlewski and Chidambaram (1993), the statistical properties of the sample mean makes the estimation of the true mean quite inaccurate, especially for small samples. Also, data availability proved to be a major issue, as data related to SIPs is hardly available to the public. Only one bank in Finland agreed to provide usable data for the thesis. However, the empirical results of the thesis have been economically and statistically highly significant, which provides a reliable basis for rejection of the null hypothesis.

The total age of the SIPs in the test sample has varied slightly between 1839 and 1877 days. This disparity between the number of days causes little unreliability. Despite the variations, the SIPs—used in the thesis—are said to be five-year products.

One potential concern of the market-adjusted methodology of the study is that the return time periods of individual SIPs may overlap. Hence, the independence assumption in the mean and median tests may not hold entirely. This issue may cause some distortions in statistical significance. At the end of the thesis, a proposal for further research—that tackles this potential problem—is presented.

1.4 Structure of the thesis

The thesis consists of both the theoretical and the empirical part. The theoretical part introduces a literature review that examines previous research on SIPs. The whole theoretical part aims to present the most important papers and to develop a coherent understanding of the topic and related concepts that will be used later in the study. The theories of building blocks for traditional capital-protected SIP are also explained. This explanation covers the basic and necessary concepts of bonds and the most critical parts of the *option theory*. This approach allows the reader to understand all the components of capital-protected SIPs. Theories related to passive index investing are also briefly described.

The rest of the theoretical part is structured as follows. After the sub-components of SIPs have been explained, the thesis moves on to put these theories together. In this manner, it is possible for the reader to logically and comprehensively understand the theory of SIPs as well as the essential concepts related to capital-protected investing.

The theoretical part ends with a section on behavioral finance and how it is linked to SIPs. Behavioral theories are another exciting frame of reference when investigating whether investors want to invest in capital-protected SIPs or other alternative investment instruments. Appropriate behavioral theories are briefly presented, but the results of previous studies are used as a guideline, as the purpose of this thesis is not to contribute to *behavioral economics*.

The empirical part of the thesis begins with a presentation of methodology and data. The slightly unusual data collection process is also briefly described. The aforementioned data and methodology are then utilized, and the results are thereinafter used when examining empirical findings. Finally, the thesis concludes with a part based on the findings of empirical evidence. Discussions of contributions as well as future research directions are also provided.

2 Literature review

This thesis is motivated by the fact that despite the decades-long existence of SIPs, the performance of these products has not yet been extensively studied. The aim of the thesis is to fill in an area of knowledge by providing new information about the Finnish SIPs. The analysis is also motivated by the author's own desire to understand the complexity of these products, and by the prior literature, which indicates that the SIPs are underperforming the market index in the long run.

The literature review is dedicated to describing the previous primary studies in the field of the thesis. The chapter is divided into two parts, and it aims to describe the most important papers and form a better understanding of the topic. In the first part, the literature on SIPs is comprehensively presented. In the second sub-chapter, previous research related to passive index investing is discussed.

2.1 SIPs

A few studies that have researched the return performance SIPs have been mostly negative. Criticism towards SIPs has been aroused in researchers by the research evidence that shows that the prices of SIPs—issued in many different countries—are way above their theoretical values at the time of issue. According to Grünbichler and Wohlwend (2005), this overpricing is also observed in capital-protected SIPs.

Despite regular criticism, the popularity of SIPs has remained relatively strong. According to research, this phenomenon is not explained by traditional rational theories of behavior. Numerous anomalies have been found that differ from market efficiency. The existence of such anomalies is difficult to explain by traditional theories, such as the *efficient market hypothesis* (EMH), as it does not take into account the limits of rational decision-making. For this reason, when examining the popularity of capital-protected SIPs, it is also essential to weight factors related to investor psychology and behavior.

2.1.1 Criticism

Deng, Dulaney, Husson, McCann, and Yan (2015) noted that SIPs were one of the major causes of the financial crisis of 2008. In the late summer of 2008, the financial markets suffered significant losses, and the issuance of SIPs fell substantially during the turmoil (Deng et al., 2015). At that time, the concept of capital protection lost much of its credibility as *Lehman Brothers* issuer risk materialized on September 15, 2008, with the largest bankruptcy filling in U.S. history (Järvinen & Parviainen, 2014, p. 49). According to Järvinen and Parviainen (2014, p. 50), investors—in capital-protected SIPs issued or guaranteed by Lehman Brothers—received only a fraction of their invested capital, as the repayments of capital for different types of bondholders was only eight per cent.

In their research paper, Deng et al. (2015) analyze the returns of SIPs on a large scale. Taking into account the statistical data, the researchers surmise that, when compared to different asset classes, the returns of SIPs are, on average, worse than those of alternative allocations—such as equities and bonds. Research evidence shows that investing in broad equity portfolios offers a higher return than SIPs on average. According to Deng et al. (2015), investors should avoid SIPs targeted at retail investors due to the high fees involved. By investing in these products, investors have earned returns that are well correlated but significantly lower than in more straightforward, more liquid instruments, such as equities.

SIPs have received much criticism. Wohlwend, Burth and Kraus (2001), Wohlwend and Grünbichler (2003), Grünbichler and Wohlwend (2005), Stoimenov and Wilkens (2005), Szymanowska, Horst and Veld (2009), Das and Statman (2013), and Abreu and Mendes (2018) reported that most SIPs tend to be overpriced and favored by the issuer. This overpricing can be seen in a study by Hens and Rieger (2008), which states that the most popular listed SIPs are overpriced enough that their expected returns are lower than the risk-free interest rate.

Jørgensen, Nørholm ja Skovmand (2011) examined the cost structure and price efficiency of the retail market for capital-protected SIPs. Researchers sum up the *present value* (PV) of the capital-protection component (bond) and use an extension of the *Black–Scholes–Merton* option pricing model (BSM) to resolve the price of the yield component (option) in the SIP. They note that capital-protected SIPs are overpriced by 6 per cent on average and that the issuers fails to report nearly half of the overpricing at the time of issue. These hidden costs have not decreased over time, although the degree of overpricing has declined.

Many studies also state that SIPs have no place in Markowitz's (1952) efficient portfolios (Das & Statman, 2013). A study by Das and Statman (2013) concludes very straightforwardly that options and SIPs cannot be part of optimally efficient mean-variance portfolios (see Markowitz, 1952). The researchers substantiate the claim quite extensively, also relying on previous studies on significant overpricing of SIPs.

The research paper of Entrop, McKenzie, Wilkens & Winkler (2014), about the portfolio holdings and trading of 10,652 small investors, was the first to measure the risk-adjusted performance of SIPs. The study found that, on average, negative alphas are realized in these products. In other words, the risk-adjusted return above the systemic beta risk of SIPs is likely to be negative. Furthermore, the research results remain in line even when the transaction costs are not taken into account. The performance of SIPs has thus been weaker than in the market as a whole. This poor performance relative to the market index is further weakened as the structure of the products becomes more complicated. The research results of Entrop et al. (2014) also show that investors make rather poor decisions when deciding on the underlying assets of their investment products themselves. These poor decisions have a depressing effect on the return performance of the investment portfolio, dropping it further away from the market returns.

In their study, Grünbichler and Wohlwend (2005) conducted a value analysis of 192 SIPs in both the primary and secondary markets. The researchers note that the value of the

SIPs is, on average, unfavorable to the investor at the time of the issue. Immediately after the issue, the prices of the products become remarkably high compared to the EUREX options. This time-dependent valuation model is explained by the issuer's efforts to take advantage of its position and maximize profits. The reasons for market inefficiencies are proposed as information asymmetry and short selling restrictions that deviate from the assumptions of traditional financial theories.

The statistics also show that the extend of misvaluation is appreciably more significant in the primary than in the secondary market. Grünbichler and Wohlwend (2005) note that the valuation in the secondary market significantly depends on time. Furthermore, the overpricing also takes place in the secondary market and is advantageous to the issuing institutions, but not as strongly as in the primary market.

Schroff et al. (2015) analyzed the impact of information demand from private investors on the trading volume of the issued SIPs. Information demand refers to the need for up-to-date, accurate, and integrated as well as ever-changing information to support specific activities at a given time. Typically, the demand for share-based information positively predicts speculative trading activity. However, studies by Schroff et al. (2015) show that for SIPs, the demand for information does not affect upward pressure on prices. Instead, interestingly, research has shown that the provision of information has had a negative effect on price pressures. Overall, *information efficiency* is rather weak in the retail market for SIPs.

In their research paper, Stoimenov and Wilkens (2005) focused on the pricing of equity-linked SIPs, comparing product prices to their theoretical values—calculated from EUREX options. The research findings are consistent with other studies, such as Grünbichler and Wohlwend (2005), as the existence of large implicit premiums was observed in the primary market. It was also noted that the tenor of the product is a vital pricing parameter in the secondary market. This research paper, like other studies, concludes that equity-linked SIPs are priced above their theoretical values on average. Compared to more traditional and more straightforward SIPs—such as fully capital-protected SIPs used in this thesis—complex products are associated with even higher premiums. An example of such a high-premium product is an *Autocallable*. This type of SIP is briefly described in chapter four. From the findings of Stoimenov & Wilkens (2005), it can be concluded that the degree of overpricing is determined at least partly by the issuer's hedging costs. However, in the secondary market, these surcharges decrease as maturity approaches.

According to Järvinen and Parviainen (2014, pp. 15–16), another common criticism of SIPs is that their costs are too high. Theories-based models argue that investors should create their own capital-protected products by using a combination of different instruments (Järvinen & Parviainen, 2014, pp. 15–16). Theoretically, an investor could build a capital-protected product, but taking into account market constraints, trading costs, and other deviations from the efficient market assumptions (see Fama, 1970), buying a capital-protected SIP from a safe issuer can be a significantly cheaper and a time-saving investment strategy (Järvinen & Parviainen, 2014, pp. 15–16).

2.1.2 Popularity

Despite widespread criticism, the popularity of SIPs has remained relatively strong (Grünbichler & Wohlwend, 2005). In the 2000s, capital-protected products have become a natural part of the portfolios of both institutional and retail investors (Grünbichler & Wohlwend, 2005; Jessen & Jørgensen, 2012; Järvinen & Parviainen, 2014, p. 13).

The total market capitalization for SIPs was approximately EUR 365 billion in 2007 (Järvinen & Parviainen, 2014, p. 29). According to Hens and Rieger (2008), in 2007, SIPs represented more than seven per cent of the total market capitalization in Switzerland and almost the same percentage in Germany. The researchers also noted that SIPs are even more popular in Europe than in the U.S.

In Finland, the market for SIPs has experienced solid growth until the end of the first decade of the 21st century, but sales volumes have not increased since then (Järvinen &

Parviainen 2014, 13). In particular, the amount of capital-protected investments has decreased significantly. This decrease is due to the low and partly negative interest rates, which effectively prevents or complicates the formation of the capital protection component (Järvinen & Parviainen 2014, p. 13). According to Finnish Structured Products Association (FSPA, 2015, 2018), partly capital-protected products are the most important product group. The relative focus has thus shifted towards more tailor-made and riskier SIPs with higher expected returns (FSPA, 2015, 2018).

2.1.3 Why do investors buy SIPs?

In their study, Jessen and Jørgensen (2012) provide explanations for the interest of retail investors in SIPs. The analysis is limited to index-linked capital protected SIPs, which also play a crucial role in this thesis. The study of Jessen and Jørgensen (2012) suggests that investors should include SIPs in their investment portfolios only if they would not otherwise be able to participate in the markets of the underlying asset, which is used as the yield component of the SIP. In addition, access to the underlying asset must provide a significant diversification benefit to cover relatively high costs.

According to Schroff et al. (2015), SIPs provide access to complex option and futures positions, without the need to enter those markets directly. Direct investment in the market—if even possible—is disadvantageous for most retail investors due to high commission and transaction costs. According to Stoimenov and Wilkens (2005), SIPs also offer many opportunities that are useful for the investor. One of these opportunities is the possibility, as mentioned above, to invest in exotic derivatives that may not be listed on derivative exchanges. The ability to take a short position in an option with an exceptionally long maturity is also seen as a factor that increases the value for the investor.

According to Schroff et al. (2015), one possible and reasonable explanation for the high premiums can also be sought from the total issuing costs incurred by the issuer. In addition to hedging, costs also arise from issuing *zero-coupon bonds* (ZCB) and providing a liquid market. The latter is often the responsibility of the issuer. According to the researchers, due to cost reasons, the profitability of the SIPs for the issuer cannot be assessed without additional information on hedging costs and other bank-specific costs.

According to Schroff et al. (2015), the market for SIPs offers an advantageous way to expand the size of the available capital markets. In this way, a diversification benefit can be achieved. The thoughts are shared by Abreu and Mandes (2018), who have examined the actual behavior of retail investors and produced evidence consistent with the view that SIPs offer higher value to some retail investors than alternative investment products. SIPs allow investors to benefit from positive price developments through different asset classes and markets that they would not have access to through other—more traditional—investment vehicles. According to the researchers, tax-based reasons and lower transaction costs may also have an effect.

Hens and Rieger (2008) found no basis for the popularity of capital-protected SIPs. They concluded that there is no evidence that the classic *expected utility theorem* (*Von Neumann–Morgenstern*) could explain the popularity of SIPs. According to Abreu and Mendes (2018), SIPs are one of the most prominent trends in the field of financial innovation. As their research implies, the popularity of SIPs among investors is difficult to explain with traditional theories based on a standardized *theory of rational choice*. This is because the studies of Abreu and Mendes (2018) found significant overpricing as well as selling at high premiums. Järvinen and Parviainen (2014, p. 22) also stated that criticism of SIPs does not take into account the behavioral economics perspective and the behavioral theory of investor psychology. Criticism of SIPs is often based on traditional views, such as assumptions about market efficiency (Das & Statman, 2013).

According to the doctrine based on theoretical market efficiency developed by Fama (1970), rational investors only invest in a cost-efficient manner, achieving the best possible returns in the long run (Järvinen & Parviainen 2014, 22). This irrationality—and the inability of efficient markets to provide answers to the challenges of the investment world—can be sought from behavioral economics where investors systematically make mistakes, and their rationality is limited (Ritter, 2003).

As stated by Hyytinen and Maliranta (2015), *limited rationality* can be used to describe the decision-making process of investors in situations where, despite their rational efforts, they cannot find optimal alternatives. Even if all the necessary information for the decision-making process is available, the decision-maker may not have the capacity to process this information to find the optimal choice (Hyytinen & Maliranta 2015). In addition, differing preferences of investors violate the assumptions of the theory of expected value (Shefrin, 2005, p. 449).

According to Shiller (1979), behavior deviating from the rationality of investors can be explained mainly with behavioral economics. The paradigms of this discipline can be used to argue that a large number of investors behave in a way called *bounded rationality*. They are also prone to many heuristics that guide investors to less optimal investment decisions from the perspective of traditional financial theories. The research paper by Das and Statman (2013), which makes a comparison between *modern portfolio theory* (MPT) and theories of behavioral theories, agrees with Shiller (1979). In conclusion, SIPs are suitable for certain types of objectives for certain types of investors.

The studies by Abreu and Mendes (2018) provide behavioral biases of investors to explain the popularity of SIPs. Examples of such bias are *overconfidence*, *gambler's fallacy*, and *loss aversion*. According to Shefrin and Statman (1994), investors fall into two common mistakes. Either they prioritize recent observations and do not attach importance to prior information, or they are guilty of gambler's fallacy and believe that recent events are appropriate predictions of long-term probabilities. These biases are likely to distort prices and increase volatility while reducing market efficiency.

Entrop et al. (2014) argue that investors in SIPs are also prone to irrational behavior called the *disposition effect*. The effect means that investors sell their investments as their value rises, but hold their positions as the value of their investments falls. Overall, it is easy to see that private investors, in particular, may need some form of protection to avoid capital losses. Such protection is provided, inter alia, by capital-protected products analyzed in the thesis.

According to *prospect theory* developed by Kahneman and Tversky (1979), the majority of investors prefer safer investment strategies as a better option. As stated by Kahneman and Tversky (1979), impairment in the value of investment causes significantly more harm for investors on average than a profit of the same magnitude causes benefit. In other words, the pain of losing seems to be more significant than the satisfaction of an equivalent gain. Therefore, a prudent investor may emphasize capital-protected products and thus increase the personal value or benefit from the perspective of prospect theory. As a result, it can be concluded that most investors belong to the group of people who experience investment losses and gains asymmetrically in their utility function. Capital-protected investments fit such an investment profile, where the utility function is non-linear (Järvinen & Parviainen, 2014).

According to the analysis by Vandenbroucke (2015), the existence and popularity of SIPs can similarly be explained based on prospect theory and its parameters (see Kahneman & Tversky, 1979). From a behavioral point of view, the research paper describes investors' interest in relatively expensive capital-protected SIPs. According to Vandenbroucken (2015), a prudent investor emphasizes capital-protected products in his investment portfolio, thus increasing the benefits he experiences from the perspective of prospect theory. The study found that investors keep SIPs in their optimized portfolios if they have sufficiently large biases.

The ability of investors to assess probabilities also proved to be a decisive factor, as Vandenbroucke (2015) found that SIPs are included in optimized portfolios only if less probable events are significantly overweighted in the minds of investors. This research result is in line with prospect theory and other studies on the same subject, which emphasize the role of *probability weighting* as an explanatory factor for the demand for SIPs.

Das and Statman (2013) argue that investors can use SIPs to improve the allocation of their investment portfolios if they suffer from *mental accounting*. According to Thaler (1999), mental accounting is a concept in the field of behavioral economics that refers to the different values investors place on money, based on subjective criteria. Investors classify their investments into different mental-level budget accounts, and exceeding the budget in one account does not affect the use of investment funds of other accounts. By combining mental accounting with the frame of reference of prospect theory, it can be said that the investor determines a gain or loss of an investment using a *reference point* that is set separately for each budget account according to mental accounting.

Thus, the investment portfolio of an investor may consist of smaller mental accounts or budget units, each related to a specific objective. These goals can be, for example, related to retirement income, education, or will. Through these goals, investors optimize each mental account individually, looking for suitable investment targets for the specific objectives and an allocation that maximizes the expected return for each account separately.

A brief example might clarify this concept. If investors are highly risk-averse due to the need to secure their retirement income or inheritance but are still interested in possible favorable market developments, it may be optimal for them to invest in capital-protected SIPs. The effectively limited risk and virtually limitless return potential of the product in question can be both an attractive and—according to the behavioral framework—optimal investment option. From the investors' point of view, the optimality of the investment option is determined by the nonlinear utility function of the prospect theory. This utility function will be presented in the later stages of the thesis.

2.2 Passive investing

It is a well-known fact that passive investing—such as index investing—has been studied widely. There is a continuous debate going on between passive and active investing. In many cases, the research has been related to the juxtaposition of active and passive investing, and there have been views among famous researchers on both sides. (Ezra & Warren, 2010).

Arguments in favor of passive investing tend to be related to the claim that it is impossible or difficult to beat the market index, even when fees and transaction costs are not taken into account as a factor in the performance of active investing. When it comes to the superiority of passive investing, references are usually made to three studies that have been done by the famous researchers: Treynor (1965), Sharpe (1966), and Jensen (1968). The early work of these pioneers set the model for risk-adjusted performance measures that are still widely used today.

One of the first papers related to risk-adjusted returns was the study conducted by Treynor (1965). His model was based on the previously developed *Capital Asset Pricing Model* (CAPM). The model has some drawbacks, but it is also an effective way to measure the risk-adjusted returns of the fund. A study based on the data of 20 funds between years 1953 and 1962 showed that—in terms of returns—funds have, on average, performed worse than the market portfolio.

According to the research findings of Sharpe (1966), from the sample of 34 active mutual funds, 11 performed better than the market index between the years 1954 and 1964. This paper was the study in which Sharpe introduced the reward-to-variability ratio for the first time. This ratio was later called the *Sharpe ratio*, and it was a new way of measuring risk-adjusted returns.

Jensen (1968) was the last of the three pioneers to publish his famous study on the subject. Unlike the previous two studies, Jensen conducted a more comprehensive study consisting of 115 equity funds between the years 1945 and 1964. He studied the efficient market hypothesis (EMH) and wanted to know if active mutual fund managers could outperform the market. In order to do that, Jensen had to develop a new measure based on the CAPM. This figure was called alpha, and it measured the excess returns earned by the portfolio. Simply put, if the excess return equals to the CAPM, the alpha equals to zero (see Formula 2). In contrast, if the excess returns on the portfolio are higher than the CAPM implies, the alpha is positive. The formulas for CAPM (1) and alpha (2) are presented below.

$$ER_p = R_f + \beta_p(ER_m - R_f), \tag{1}$$

and

$$\alpha_p = ER_p - (R_f + \beta_p(ER_m - R_f), \tag{2}$$

where

ER_p= expected return of the portfolio

R_f= risk-free rate

β_p= beta of the portfolio (computed by regressing the portfolio returns against the market returns)

$ER_m - R_f$ = market risk premium.

Jensen (1968) showed that, on average, active mutual funds have failed to beat the buy-and-hold market portfolios. As previously noted, Jensen (1968) also argues that mutual fund managers have not even managed to cover the brokerage fees charged for their activities. More specifically, funds of those managers were not able to outperform the market-adjusted returns of the CAPM, not even before the deduction of the costs.

Wolley and Bird (2003) concluded that because the performance of active mutual fund managers is often measured relative to market benchmarks, a situation arises in which money increasingly flows from active to passive investments. According to Wolley and

Bird (2003), this effect has made the returns of active mutual funds less volatile and easier to predict. Net returns of the active mutual funds have also increased due to the deducted costs.

According to Woolley and Bird (2003), passive index investing also has other interesting effects. It is generally agreed that stocks that are included in a stock index become, on average, more liquid than the stocks that are not there. This higher liquidity leads to an increased investor interest towards the stocks in an index. According to researchers, a stock that is included also enjoys easier access to the capital market at a lower price. As a chain reaction, it can be seen how index companies may make less efficient investment choices as a result, which in turn leads to lowered returns. This phenomenon is called—according to Woolley and Bird (2003)—the *cost of passive investing*.

However, it is essential to emphasize that the authors of more recent studies have proposed that there is some evidence of the benefits of active investing as well. A paper by Grinblatt and Titman (1993) finds that between the years 1975 and 1984, growth funds and active growth funds managed to provide abnormal returns compared to the market portfolio. Interestingly, according to researchers, some managers consistently managed to beat their benchmarks and thus better justify higher fees compared to passive investing.

In their study on the characteristics of fund managers, Daniel, Grinblatt, Titman, and Wermers (1997) came to the conclusion that while managers are able to show some skill in stock picking, they seem to lack the ability to time their investment choices. In addition, the authors state that measures of timing and selectivity, taken together, constitute the hypothetical return of a fund and that the performance based on these measures is statistically significant.

Moreover, according to the study, while fund managers have been successful in generating abnormal excess returns, this difference in returns compared to passive investing is no longer statistically significant after deducting the costs and fees. The final conclusion of the study by Daniel et al. (1997) is that between the years 1975 and 1984, the abnormal returns provided by fund managers were mainly due to the use of widely known investment strategies such as *momentum*.

Some studies have sought to explain the popularity of active investing by arguing that it is not only the returns and fees that matter but psychology too. According to French (2008), behavioral theories can explain investor interest in active investing. He notes that the *overconfidence bias* causes them more likely to ignore or not to believe in the fact that, on average, an investor loses in a *negative-sum game*. Furthermore, several papers suggest that overconfidence leads to an increased willingness to pay higher fees and, in general, invest more actively (Odean, 1998; Barber and Odean, 2001; Statman, Thorley, and Vorkink, 2006).

French (2008) states that people may not understand well enough the investment decisions they plan or make, and thus may not be able to fully take into account all the costs that may be associated with investing. One interesting point made by French (2008) is also that the continuous marketing of active trading confuses less sophisticated investors. Statman (2004) also concludes that some investors are looking for a certain kind of emotional pleasure associated with the occasional outperformance of the fund. Considering this finding, it can be surmised that investors may be willing to sacrifice part of the expected returns in search of these positive feelings. Finally, French (2008) also states that it is possible to be superior among investors and thus be able to make investing sufficiently profitable, but this simply does not explain the actions of the average investor.

3 Bonds and options

This chapter aims to build a coherent and comprehensive understanding of the building blocks of traditional capital-protected SIP by presenting the basic and essential concepts of bonds and options. After this explanation, the reader will be able to quickly understand the following Chapter 4 about the structure and risks of SIPs.

3.1 Bonds

The legal form of capital-protected SIPs is typically a bond. In a bond, the issuer (the debtor) undertakes—in accordance with the agreed terms—to pay a pre-agreed fixed return to the investor (the creditor or holder) and to repay the notional principal amount following a specific schedule and terms. (Järvinen & Parviainen 2014, p. 59.) In the case of SIPs, capital protection is built with zero-coupon fixed-income investment. It is a non-interest-bearing investment with a *face value* (FV) repaid on the maturity date. (Järvinen & Parviainen 2014, p. 139.) This chapter briefly introduces the theory of bonds, risks, and credit ratings, as well as the operations of bond markets.

3.1.1 Characteristics

The bonds are divided into several different types, and their issues are made available to the general public. The issuer may be, for example, a financial or insurance institution, state, municipality, or company. The issuer issues a bond for the purpose of raising funds from investors by promising a payment or multiple payments in the future.

A bond is a marketable fixed interest debt instrument that is often issued at FV. The coupon is typically paid on the FV with the payment interval, which varies from loan to loan. The bond may also be without coupons, but then it will be issued below its FV. The main components of the bond are presented in Table 1. (Bodie, Kane & Marcus 2014, p. 34, p. 444; Berk, DeMarzo & Harford, 2015, p. 184.)

Table 1. Bond characteristics (Berk et al., 2015).

Bond certificate	terms, issuer, ownership, dates, coupon rate, payments.
Coupon	interest paid by the issuer in proportion to the bonds FV.
Maturity date	redemption date, the date of repayment.
Face value (FV)	amount to be paid back to the investor at maturity.
Credit rating	credit risk evaluation, affecting the price of the loan.

3.1.2 Pricing

The price the investor pays for a bond depends on the present value (PV) of future cash flows (CFs). In other words, future coupons and principal are discounted to the present. The calculation of PV is affected by interest rates and maturity. (Bodie et al., 2014, p. 446.) According to Berkin and DeMarzo (2015, pp. 186–187), the simplest type of bond is a *zero-coupon bond* (ZCB) that, as its name implies, does not pay any interest during its lifetime. A ZCB trades at a deep discount below its FV, generating a profit at maturity date when the bond is redeemed for its full FV. The return of a ZCB simply consists of the *yield to maturity* (YTM), which is the difference between the FV and the issue price. (Brealey, Myers & Allen, 2014, 607; Järvinen & Parviainen, 2014, 259; Hull, 2015, 241-242l.) The PV of a ZCB can be calculated using formula 3.

$$PV = \frac{FV}{(1+YTM_n)^n}, \tag{3}$$

where

PV = present value

FV = face value

n = number of periods

YTM = yield to maturity. (Bodie et al., 2014.)

Therefore, the total return or YTM anticipated on a ZCB—if it is held until maturity—can be solved as follows:

$$YTM_n = \left(\frac{FV}{PV}\right)^{\frac{1}{n}} - 1. \tag{4}$$

The discount rate includes an additional premium that reflects the risk of the bond. Such risks include liquidity, inflation, interest rate, currency, and issuer risk. The most significant of these is considered to be the issuer risk, which is related to the issuers' ability to repay. The value of a bond can be computed simply by discounting the expected CFs with an appropriate discount rate. Thus, the value of a bond is obtained by adding together the PV of coupons and FV of the bond.

$$PV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} + \frac{FV}{(1+r)^T}, \tag{5}$$

where

$T =$ maturity date

$C =$ coupon rate

$r =$ discount rate. (Bodie et al., 2014.)

It can be seen from Formula 5 and Figure 1 that there is a negative relationship between the discount rate and the value of a bond. As the discount rate increases, the value of the bond decreases, and vice versa.

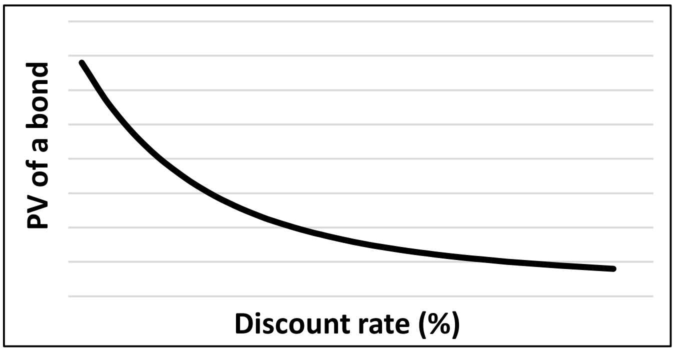

Figure 1. Inverse relationship between the discount rate and the bond value. (Bodie et al., 2014, pp. 454–455).

The payment of each coupon is discounted based on its payment date. Assuming that the coupon rates are the same throughout the lifetime of a bond, the value can be calculated using the following formula. (Bodie et al., 2014.)

$$PV = C\ x\ \frac{1}{r}\left[1 - \frac{1}{(1+r)^T}\right] + FV\ x\ \frac{1}{(1+r)^T}. \tag{6}$$

Due to the time value of money, the value of a ZCB increases as it matures. In other words, over time, the value of the bond approaches its FV. For this reason, a ZCB must be sold at its FV on the maturity date. (Bodie et al., 2014, pp. 466–467.) Figure 2 illustrates how the price of a ZCB rises exponentially when approaching maturity. In the figure, there is a 30-year bond with a yield of 10% and a notional value of EUR 10,000. The PV of this ZCB equals to EUR 573.09 (see Equation 3).

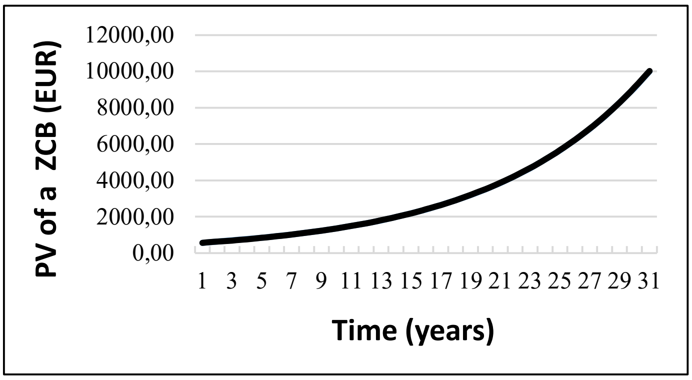

Figure 2. Relationship between the maturity and the value of a ZCB (Bodie et al., 2014, 466–467).

3.1.3 Bond rating system

There is always some risk associated with future CFs, for the most part, due to the issuer risk mentioned earlier in this study. This risk is primarily measured by Standard & Poor's, Moody's, and Fitch, which are major international credit rating agencies. In terms of the bond market, the role of the credit rating agencies is vital. These agencies predict the issuer's ability to meet its future payment obligations.

If an entity has a high credit rating, the risk of its insolvency is shallow in the coming years. This trust in easy repayment leads to the entity's ability to borrow money from the market at a relatively low price. (Bessembinder & Maxwell, 2008; Bodie et al., 2014.)

Table 2. Credit symbols (Hull, Predescu & White, 2004; de Haan & Amtembrink, 2011).

S & P	Moody's	Fitch
AAA	Aaa	AAA
AA+	Aa1	AA+
AA	Aa2	AA
AA-	Aa3	AA-
A+	A1	A+
A	A2	A
A-	A3	A-
BBB+	Baa1	BBB+
BBB	Baa2	BBB
BBB-	Baa3	BBB-
BB+	Ba1	BB+
BB	Ba2	BB
BB-	Ba3	BB-
B+	B1	B+
B	B2	B
B-	B3	B-
CC+	Caa1	CC+
CCC	Caa2	CCC
CCC-	Caa3	CCC-
CC	Ca	CC
C	C	C
D	D	D

The three major credit rating agencies report their credit ratings using symbols of credit-worthiness. At Moody's, the highest creditworthiness supported by many factors is marked by the symbols Aaa, and the given ratings are always between Aaa and D. Similarly, S&P and Fitch mark their best ratings with AAA, and ratings range from AAA to D. To be considered as investment grade, the company must be rated at least BBB. Companies rated BB or lower are considered as a speculative grade. As the letter implies, D stands for default. Moody's refines its credit rating scale by assigning the numbers 1, 2, or 3 after the letter symbols. S&P and Fitch, in turn, use plus and minus signs. (Hull, Predescu & White 2004; de Haan & Amtembrink 2011.) The credit symbols of the three major credit rating agencies are presented in Table 2.

3.1.4 Zero rates

According to Hull (2015), the rate of interest generated by an investment that starts today and lasts for n years is called the n-year zero-coupon interest, the n-year spot rate, the n-year zero rate, or n-year zero. In this case, the principal and all the interest are paid to the bondholder at the end of n years. Assuming a five-year zero-coupon interest rate of 5% per annum, it can be computed that EUR 100.00 invested today for five years increases to

$$\text{EUR } 100.00 * 1.05^5 = \text{EUR } 127.63,$$

or with continuous compounding to

$$\text{EUR } 100.00 * e^{0.05x5} = \text{EUR } 128.40.$$

As previously noted, a coupon interest is typically paid on the FV of a bond with a pre-agreed payment interval. For this reason, most of the interest rates on the market are not so-called zero-coupon rates. By assuming a five-year government bond with a coupon rate of 5%, it can be explained how the price of a bond does not determine the five-year Treasury zero-coupon rate. This is because, as aftermentioned, a part of the return on the bond is realized in the form of coupon payments before the maturity date.

When structuring a fully capital-protected SIP, a large portion of invested capital is invested in ZCB. This investment provides full protection for invested initial capital, as the value of the ZCB rises—on the maturity date— to a pre-agreed 100%-level of capital protection. As Järvinen and Parviainen (2014, p. 59) noted, this feature of repayment has led to a term of capital protection.

3.2 Options

An option is one of the two components of a capital-protected SIP. This sub-chapter is broader than the previous one, as the theory and pricing of options are much more complex than ZCBs. In one of the most widely used financial textbooks, option theory has also been named as one of the seven most important ideas in the field of finance (see Brealey et al., 2014, p. 882.). In a traditional equity-linked SIP, the option forms a yield component that allows for a return in a situation where the value development of the underlying stock index is favorable.

Next, the theory of options will be introduced, the factors influencing the price will be reviewed, and the well-known *Black–Scholes option pricing model* (BSM) will be presented. The review is limited to *European options* in order to simplify the thesis and to limit the already wide range of topics. According to Hull (2012, p. 194), most theories related to options are based on European options due to the simplicity of their analysis and pricing. However, Hull mentions that most trading is done with *American options*. This is logical, as American options lose their value as they approach maturity. The second reason is that American options can be exercised at any time, unlike European options. An option payoff diagram is presented to illustrate the return and risk profiles of options. Visualization of return and risk profiles is conducive to understanding the formation and diversity of returns on SIPs.

3.2.1 Characteristics

Nowadays, there are myriad kinds of options. Options are financial vehicles that are derivatives based on the value of underlying assets. Examples of these are stock, index, and currency options. One of the most common and most exercised options is a stock option, in which the company's share is the underlying asset (Hull 2015, 213). Options in the options market can be divided into two main categories—call options and put options. A call option is a right—but not an obligation—to purchase the underlying instrument at a pre-determined time at a pre-agreed exercise price. A put option, in turn, entitles its holder to sell the underlying asset at a pre-determined time at a pre-agreed exercise price.

Trading takes place on the *over-the-counter* (OTC) market or through derivatives exchanges, such as EUREX. Another important dichotomy is made between the European and American options. A European option can only be exercised on a pre-determined expiration date, while an American option is exercisable throughout its lifetime. In addition, options that can be exercised on pre-determined dates—often on one day each month—are called *Bermuda options*. (Black & Scholes 1973; Hull 2012.)

Depending on the type of option, the seller (writer) has a mandatory obligation to either buy or sell the underlying instrument at the agreed strike price. Due to the fundamentally unlimited risk, the writer receives a premium as compensation, which at the same time constitutes the seller's maximum return on the option. By combining the above, four types of options are obtained:

1. Long call.
2. Short call.
3. Long put.
4. Short put.

The four types of options form four different parties to the options market. Buyers have bought long (long position), and sellers have sold short (short position). (Hull 2015, pp. 10–11.)

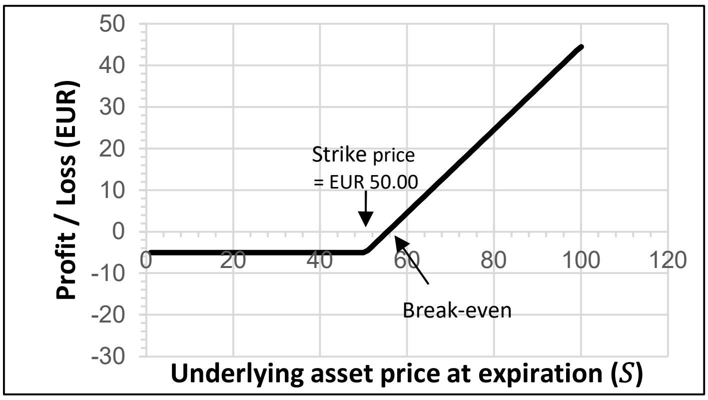

Figure 3. Call payoff diagram (Hull 2015, p. 11).

It can be seen from Figure 3 how a long position with a call option creates a return profile in which the buyer of the option benefits from an increase in the price of the underlying asset. Similarly, the writer of that option benefits if the price of the underlying asset remains at the same level or decreases.

3.2.2 Pricing

This part discusses the pricing of options by firstly presenting the commonly used notation and the factors influencing the pricing. Also, the well-known option pricing model Black–Scholes (BSM) with its parameters is presented. The factors influencing the pricing are the same for call and put options, but the directions of the effects vary. Below are typical factors that affect option pricing.

1. S_0 = the price of the underlying asset at time zero
2. K = the pre-determined exercise price (strike price) of the option
3. T = time measured in years, generally 0 = now, and T = expiry
4. r = continuously compounded annualized risk-free interest rate
5. σ = the volatility of the underlying asset
6. D = expected dividends. (Cox & Rubinstein, 1985.)

The price of the underlying at time zero is defined as the most recent amount paid by the investor for the underlying asset. The main determinant of the option price is the exercise price, which is the amount by which a particular derivative contract can be exercised. The price of the call option and the exercise price have a negative relationship. The following notation is also typically used in option pricing.

1. S_T = the price of the underlying at the expiration date of the option (at time T)
2. c = the price of a European call option
3. p = the price of a European put option
4. C = the price of an American call option
5. P = the price of an American put option. (Hull, 2015, pp. 234–235.)

3.2.2.1 Volatility

Volatility is a measure of the standard deviation of the return on a particular security or market index over a period of time. Therefore it is an indicator of risk and uncertainty. In general, the price of an option increases as volatility increases, as a large standard deviation of returns leads to greater risk. (Hull, 2015, pp. 234–238, p. 325.) Thus, it can be said that there is a positive relationship between volatility and the price of an option. Volatility, standard deviation, and risk are often understood among investors and financial experts in a rather multidimensional way.

In financial research, volatility is often measured by the standard deviation. The usual estimate, $\hat{\sigma}$, expected standard deviation (see Equation 8 & 9) is obtained by taking the square root of the variance (see Equation 7).

$$\hat{\sigma}^2 = \frac{1}{N-1} \sum_{t=1}^{N} (R_t - \bar{R})^2, \tag{7}$$

and

$$\hat{\sigma} = \sqrt{\frac{1}{N-1} \sum_{t=1}^{N} (R_t - \bar{R})^2}, \tag{8}$$

or

$$\hat{\sigma} = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} R_t^2 - \frac{1}{n(n-1)} (\sum_{i=1}^{N} R_t)^2}, \tag{9}$$

where

$\hat{\sigma}$ = expected standard deviation

N = number of observations

$\bar{R}$ = mean return

and let

R_t = return over a period of time = $\ln(\frac{S_i}{S_{i-1}})$ for i = 1, 2,…, n,

where

S_i = stock price at the end of i^{th} interval, with i = 0, 1,…, n. (Poon & Granger, 2003; Hull, 2015, pp. 326–327.)

Risk is generally measured as a percentage, and the frequency is typically one year. If the realized risk of an asset has been ten per cent, then the returns have deviated from the average so that the result is ten per cent. When calculating life of an option and estimating volatility levels traders tend to ignore calendar days when the exchange is closed. This ignoring occurs due to significantly lower volatility levels when the exchanges are closed. With regard to this, the annual price volatility can be computed from the volatility per trading day by utilizing the equation below. (Hull, 2015, p. 328.)

$$Volatility\ p.a. = Volatility\ per\ trading\ day * \sqrt{No.of\ trading\ days\ p.a.} \quad (10)$$

The life of an option is usually calculated as T years by also using trading days instead of calendar days. The formula is presented below.

$$T = \frac{No.\ of\ trading\ days\ until\ option\ maturity}{252}. \quad (11)$$

If the standard deviation is associated with a standard distribution, such as a normal or t-distribution, the required probability density as well as the cumulative probability density can be derived analytically. Thus, the standard deviation tends to determine the probability for each deviation from the expected value using the standard deviation of the normal return distribution. In other words, if the standard deviation is not combined with usable distribution or dynamic pricing, it is a problematic estimate for measuring risk due to its inaccuracy. Thus, measuring the risk using standard deviation only makes sense if it is used in the case of a normal distribution or a few other standard distributions. (Poon & Granger, 2003.)

However, predicting volatility based on historical data has some features that make estimation difficult. For instance, the smaller the sample size, the larger the sampling error. This is due to a small sample that may coincidentally deviate significantly from the population. According to Figlewski and Chidambaram (1993), the statistical properties of the sample mean makes the estimation of true mean quite inaccurate, especially for small samples.

Volatility reflecting the past calculated from historical values can also be used to estimate future variance. (Poon & Granger, 2003.) However, this is not the only option, as in addition to historical data, volatility can also be implicitly determined by using option pricing models (Hull 2015, p. 321). The estimate in question called *implied volatility* will be discussed later in the context of the BSM model.

3.2.2.2 Other factors affecting the price of options

The risk-free interest rate is the rate of return that investors would expect from a completely risk-free investment over a specified time period. Investors' return expectations increase as the risk-free interest rate rises, as the PV of future CFs decreases due to the increased discount rate. The same is true for options, as other factors remain unchanged, there is a positive relationship between the call option and the risk-free interest rate. In the case of a put option, the dependence is negative.

The effect of expected dividends on option prices is the opposite. This is because the dividend payment should—at least in theory—lower the share price by a corresponding amount. Thus, as the value of the underlying asset decreases, the price of the call option decreases, and the price of the put option increases. (Hull, 2015, pp. 234–238.) This relationship is the reason why higher *participation rates* can be achieved for SIPs by using high-dividend indices as underlying assets. The underlying index tracking a market with a high dividend yield decreases the acquiring price of the yield component (call option leg) of the SIP. This issue will be further discussed in the sub-chapter 3.2.3.

According to option theory, the option price (premium), consists of components called *intrinsic value* and *time value* (Poon & Granger, 2003). The intrinsic value can be defined as the value that would be obtained if the option were exercised immediately. Therefore, this value is the difference between the current price of the underlying asset and the pre-determined exercise price, which—because of its nature—can never be negative. The intrinsic value of an option is often lower than its premium. This phenomenon is due to the time value based on the option holder's possibility to benefit from the favorable change in the price of the underlying asset prior to maturity.

The time value of an option is obtained as the difference between the option price and the intrinsic value. (Hull 2015, p. 220.) The high volatility and long maturity of the underlying asset have a positive effect on the option time value. This is because the longer the maturity, the greater the probability that the price of the underlying asset will rise above the exercise price. High volatility increases the probability that the price of the underlying asset will differ significantly from the exercise price. (Natenberg, 1994.) Thus, option prices are formed by the formulas:

$$c = \max[S_0 - K, 0] + time\ value, \tag{12}$$

and

$$p = \max[K - S_0, 0] + time\ value, \tag{13}$$

where, as previously noted

c = the price of the European call option

p = the price of the European put option

S_0 = the price of the underlying asset at time zero

K = the strike price of the option. (Hull, 2015, p. 220.)

According to Hull (2015, p. 220), options can also be divided according to their intrinsic value. Below are the terms for options with an intrinsic value of positive, zero, and negative, respectively.

1. In the money (ITM).
2. At the money (ATM).
3. Out of the money (OTM). (Hull, 2015, p. 220.)

Table 3 seeks to illustrate the terminology in question. In the case of an ITM option, $S_0 > K$. Similarly, a put option is ITM when $S_0 < K$. An option with $S_0 = K$ is called ATM. On this basis, in a world free of trading costs, the ITM European option is always exercised on its expiration date. (Hull, 2015, p. 220, p. 819.)

Table 3. Intrinsic and time value of an option (Hull, 2015, p. 220).

	Call	Put
$S_0 > K$	**Intrinsic value > 0** In the money ITM	**Intrinsic value = 0** Out of the money OTM
$S_0 = K$	**Intrinsic value = 0** At the money ATM	**Intrinsic value = 0** At the money ATM
$S_0 < K$	**Intrinsic value = 0** Out of the money OTM	**Intrinsic value > 0** In the money ITM

3.2.2.3 Options on stock indices

Index options are particularly important to this thesis as they are widely used to construct the traditional capital-protected SIPs. The thesis focuses on the fully capital-protected SIPs combined with a stock index call options. The return performance of the SIPs is compared with the suitable stock market indices. This sub-chapter briefly explains stock indices and presents a usual way they can be utilized.

Chicago Board Options Exchange (CBOE) trades, inter alia, European index options on the *S&P 500* (SPX), *Dow Jones Industrial Average* (DJX), and *Nasdaq 100* (NDX). American and European index options are also traded on the S&P 100 (OEX & XEO), for example. More customized flex and LEAPS options are also offered on indices. Some indices follow the price movements of a particular sector and others market as a whole. (Hull, 2015, p. 367).

Index options are always settled in cash, and one option contract is generally 100 times the index. According to this, when the option is exercised, the holder receives $(S - K) * 100$, and the seller pays the amount in cash, where S is the closing value of the index on the expiration date. Conversely, in the case of a put option, one with a long position receives $(K - S) * 100$ in cash from the writer.

One purpose of use for index option may be, for example, when the value of the index is S_0 and the portfolio manager responsible for a well-diversified portfolio (*beta* $= 1$) wants to limit the *downside risk* (insurance). The percentage changes in the price of the index can be expected to be the same as the percentage changes in the value of the portfolio if the portfolio dividends are assumed to be exactly the same as the dividends from the index. In this scenario, if the portfolio manager purchases one index put option with an exercise price of K for each $100S_0$ dollars in the portfolio, the value of the portfolio is hedged against the possibility of the index price falling below K.

3.2.2.4 Black-Scholes model

This section presents the Black–Scholes (BSM) model, which, according to Bodie, Kane, and Marcus (2008), is both the most widely used and the best-known model utilized for option pricing. However, due to complex pricing, there is not just one pricing model to suit every situation. In addition to the BSM model and its modifications, there are numerous models suitable for different situations. These include the Lattice models, the *Monte Carlo simulation*, the *Finite difference methods*, the *Heston model*, and the *Variance–Gamma model*. (Bakshi, Cao & Chen, 1997; Bodie et al., 2008.)

The Black–Scholes model—also known as the Black–Scholes–Merton (BSM) model (see Hull, 2015, p. 321)—is based on the simple logic that in an efficiently priced market, there is no possibility of completely certain returns by combining short and long options and their underlying assets (Black & Scholes, 1973). The BSM was developed in 1973 to determine the price of a European option, although later extensions suitable for American options have also been made (Blake 2000, p. 312). To support the original model, Black and Scholes (1973) assumed the so-called ideal conditions which are presented below.

1. The risk-free rate of interest is generally known and remains constant until maturity.
2. The price development of the underlying asset follows the *random walk process*, and the price of the underlying asset on the expiration date of the option is lognormally distributed. Thus, price changes in the underlying asset are independent and follow a normal distribution, and large rate fluctuations are not possible. Volatility is constant.
3. There are no dividends or other premiums prior to maturity.
4. The options are European. They can only be exercised on the expiration date.
5. Trading in shares and options is ongoing and does not involve any transaction costs or taxes.
6. Any fraction of the price of a security may be borrowed at a risk-free rate.
7. Short selling is possible. A seller who does not own the security accepts the price from the buyer and agrees to pay a certain amount in the future at an amount equal to the price of the security on that day. (Black & Scholes, 1973; Poon & Granger, 2003; Yen & Lai, 2014, p. 38).

Although the current price of a share and an option does not correlate with past price changes, the future price level can still be estimated (Nikkinen, Rothovius & Sahlström, 2002, pp. 80–82). The BSM model assumes that the share and option prices follow the *stochastic Wiener process* (Hull, 2012, pp. 280–281). This model—which models the behavior of a variable—is called the *geometric Brownian motion*:

$$\Delta S = \mu S \Delta t + \sigma S \epsilon \sqrt{\Delta t}, \quad (14)$$

where

ΔS = change in the price of the underlying asset

μ = expected return

Δt = small time interval

σ = volatility

ϵ = normal distribution with mean zero and standard deviation one.

The theory is based on a naturally occurring phenomenon observed by Robert Brown in 1827 and demonstrated by physicist Albert Einstein in his calculations in 1905, in which water molecules cause fluid particles to make a random and completely independent reciprocating motion by colliding with each other. (Einstein, 1905; Hull, 2012, pp. 287–288.)

Under the assumptions of the BSM model, the option price depends only on the price of the underlying asset, time, and variables that are considered constant. Thus, a hedged position can be formed by taking a long position in an underlying asset and a short position in an option, the value of which thus does not depend on the value of the underlying asset, but only on time and known constants. In other words, the underlying asset and the put option can be formed into a momentarily risk-free portfolio, the return of which corresponds to the risk-free rate. Thus, the formulas of the BSM model for the European call and put option are formed as follows:

$$c = S_0 N(d_1) - K e^{-rT} N(d_2), \quad (15)$$

and

$$p = Ke^{-rT}N(-d_2) - S_0N(-d_1), \tag{16}$$

where

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma T^{\frac{1}{2}}}, \tag{17}$$

and

$$d_2 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - \frac{\sigma^2}{2}\right)T}{\sigma T^{\frac{1}{2}}} = d_1 - \sigma T^{\frac{1}{2}}, \tag{18}$$

where

$N(\cdot)$ = cumulative distribution function for standard normal distribution with value d

$N(d_2)$ = the probability that the call option will be ITM (exercised) in a risk-neutral world on its expiration date (at maturity). (Hull, 2015, pp. 335–336.)

The term $N(d_1)$, sometimes referred as delta, on the other hand, is much more difficult to interpret. The delta is the changing rate of option value if stock price changes by one unit. $S_0N(d_1)e^{rT}$ is the expected price of the underlying asset in a risk-neutral world at time T and the price of the underlying asset that is below the exercise price is calculated to be zero. Thus, the strike price is paid only when the price is greater than K. The probability of this is $N(d_2)$ as mentioned above. Hence, the expected return in a risk-neutral world can be calculated by the Equation 19. (Hull, 2015, pp. 336–337).

$$S_0N(d_1)e^{rT} - KN(d_2), \tag{19}$$

The European call option formula (see Equation 15) presented above can be formed from Equation 19 by discounting it from time point T to time point zero (Hull, 2015, p. 337).

$N(x)$ is always between zero and one, and it is a probability that the random variable is less than or equal to x. Thus, S_0 multiplied by $N(d_1)$ refers to current stock price being weighted with probability. In rough terms, $Ke^{-r}\ N(d_2)$ is the strike price discounted back and being weighted with the probability of the actual willingness of option holder to pay the exercise price at maturity. The higher the current stock price relative to the strike price, higher the worth of the option and higher the probability that the European call option will be exercised at maturity. As can be seen from the equations above, the higher $ln\ (\frac{S_0}{K})$ ratio in the d_1 and d_2 means larger input for the cumulative distribution function which represents higher change of exercise. This logically leads to the higher value of an option.

In their study, Black and Scholes (1973) made two very remarkable findings related to expected returns and risk premiums. According to these findings, the calculation of the option price does not require the determination of a risk premium at all. The expected return on the underlying asset is also not dependent on the price of the option. As already mentioned, the BSM model is based on, inter alia, the log-normal return distribution of the underlying asset, standardized volatility, and the random walk process.

However, studies conducted after large stock market fluctuations have found that the implied volatilities of ITM and OTM options are higher than those of ATM options. For this reason, the BSM model may fail to determine the value of options, at least in theory. The phenomenon is called the *volatility smile,* and it is illustrated in Figure 4. The effect can be considered as an important component in the development of option pricing models. In addition, Yen and Lai (2015, p. 39) state that the implied volatility of stock index options—which are also used in capital-protected equity-linked SIPs—typically increases as one moves further away from ATM. (Dumas, Fleming & Whaley, 1998; Andersen & Andersen, 2000; Poon & Granger, 2003; Hull, 2012, pp. 411–413; Hull, 2015, pp. 431–443.)

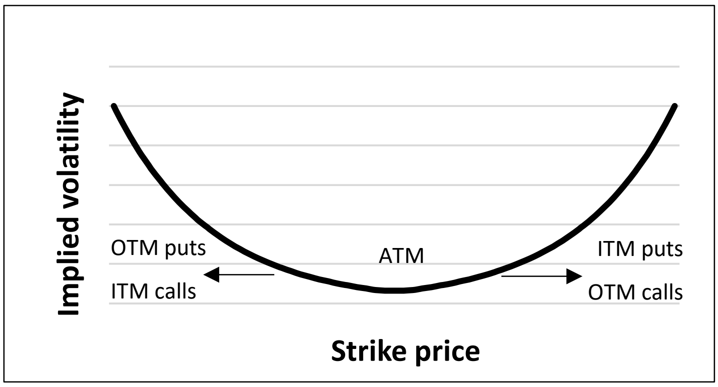

Figure 4. Volatility smile (Dumas, Fleming & Whaley 1998; Andersen & Andersen, 2000; Poon & Granger, 2003; Hull, 2012, pp. 411–413; Hull, 2015, pp. 431–443).

3.2.2.5 Dividends

Merton (1973) extended the original BSM model to include continuously compounding dividends into the formula. This idea was triggered by the problem-causing and unrealistic assumption that there are no dividends prior to maturity. Merton's extension of the BSM formula is presented for calls and puts in Formulas 20 and 21 below. The model is slightly more realistic than the original, but it still has several assumptions that are not realistic.

$$c = N(d_1)Se^{-q(T-t)} - N(d_2)Ke^{-r(T-t)}, \tag{20}$$

and

$$p = N(-d_2)Ke^{-r(T-t)} - N(-d_1)Se^{-q(T-t)}, \tag{21}$$

where

$$d_1 = (1/(T-t)^{\frac{1}{2}}[\ln\left(\frac{S}{K}\right) + (r - q + \frac{\sigma^2}{2}(T-t)], \tag{22}$$

and

$$d_2 = d_1 - \sigma(T-t)^{\frac{1}{2}}, \tag{23}$$

where

$N(\cdot)$ = cumulative distribution function for standard normal distribution with value d

$T - t$ = the time to maturity

S = the spot price of the underlying asset

K = the pre-determined exercise price

r = the continuously compounded annualized risk-free rate

q = the continuously compounded annualized dividend yield

σ = the volatility of the underlying asset. (Merton, 1973.)

One way to value options with dividends is also simply to calculate the PV for the dividends and subtract it from S_0. Consider a 6-month European call option on stock which has ex-dividend dates in two and five months. The dividend is assumed to be EUR 1.00, and the share price, as well as the strike price, is EUR 50.00. The risk-free interest rate and annual volatility is 10% and 25%, respectively. Thus, the PV of the dividends is EUR 1.9427 ($1.0e^{-0.1*2/12} + 1.0e^{-0.1*5/12}$). Now, S_0 can be changed to EUR 48.0573 ($50.00 - 1.9427$), and Equations 17 and 18 can be utilized to calculate the cumulative distribution functions for standard normal distributions with value d.

$$d_1 = \frac{\ln\left(\frac{48.0573}{50.00}\right) + \left(0.1 + \frac{0.25^2}{2}\right)0.5}{0.25 * 0.5^{\frac{1}{2}}} = 0.1471,$$

and

$$d_2 = \frac{\ln\left(\frac{48.0573}{50.00}\right) + \left(0.1 - \frac{0.25^2}{2}\right)0.5}{0.25 * 0.5^{\frac{1}{2}}} = 0.1471 - 0.25 * 0.5^{\frac{1}{2}} = -0.0297.$$

NORMSDIST Excel function gives $N(d_1) = 0.5585$ and $N(d_2) = 0.4882$, so from Equation 15, the call price is

$$48.0573 * 0.5585 - 50.00^{-0.1*0.5} * 0.4882 = 3.62.$$

In addition, the *delta, gamma, vega, theta, and rho* of this dividend-paying equity call option are 0.5585, 0.0465, 0.1341, -0.0155, and 0.1161, respectively (see subchapter 3.2.3. & Table 4).

In stock index options, it is often supposed that dividends are a known constant proportional stream. However, Harvey and Whaley (1992) argue that this procedure can lead to great errors in pricing. In Finland, dividends are normally paid annually in March or April (once a year), and therefore an estimate of the constant proportional dividend flow is argued to be inappropriate. One could possibly be able to use a *synthetic index* calculated from the *futures contracts* by using the *cost-of-carry* relationship. In this way, dividend adjustments would be made implicitly by the market.

3.2.2.6 Implied volatility

As previously presented, volatility can be estimated based on historical price data. However, a more common way is to use so-called implied volatility, which refers to the market's expectation of the future intensity of the price changes of the underlying asset during the term of the option (Mayhew, 1995; Hull, 2015, pp. 341–342). Historical volatility looks to the past, while implied volatility focuses on the future. In general, especially among traders, people talk about implied volatilities rather than option prices. This is due in part to the fact that implied volatility generally fluctuates less than the option price. (Hull, 2015, pp. 341–342).

However, implied volatility cannot be directly observed from the market, but must be calculated based on other factors in an option pricing model by taking an inverse function with respect to volatility. Therefore, it is a parameter that can be determined, for example, by the BSM model or the *Cox–Ross–Rubinstein binomial model*. Once the option price, exercise price, and other parameters are known, the value of the implied volatility can be iterated. (Mayhew, 1995; Poon & Granger, 2003).

Assume a 6-month European call option on the EuroStoxx index with current index point and exercise price (K) of 3,200. The dividend yield (D) is 10%, the risk-free rate (r) of return in Europe is 3% per annum, and the call option (c) is currently trading at EUR 43.65. The implied volatility (σ) can be computed by trial and error. Volatility of 15% gives a call option price of EUR 83.88; volatility of 5% gives an call option price of EUR 9.30; and so on. The true implied volatility of the index option of this example is 10%.

As mentioned above and proved in the example, the increase in volatility has a positive effect on option prices, as it increases the probability that the option will have value—that is, it is ITM—at its expiration date. Volatility cannot be used to estimate the direction of market fluctuations, but the expected intensity of the fluctuation can be observed. However, the high volatility of the market can be exploited through various option strategies, such as the one in Figure 5. The strategy is called *straddle*, which is made up of long ATM call and put options with the same maturity, strike prices, and underlying assets.

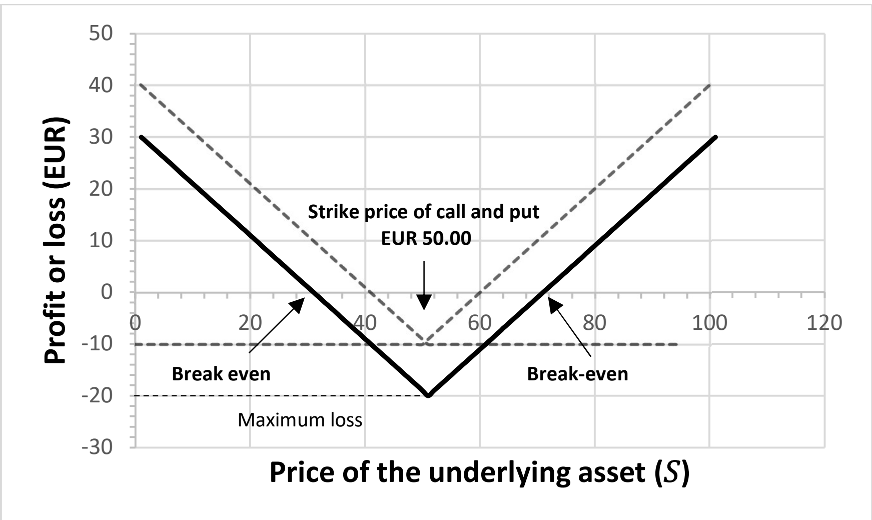

Figure 5. Straddle.

3.2.3 Risk management

Financial institutions selling options face risk management issues. A financial institution can easily cover its sales position by buying the same option on the market (Deng et al., 2015). However, this is easily achieved only if the option in question is traded on an exchange. Hedging becomes much more cumbersome when the option is customized. (Hull, 2015, p. 399). However, the portfolio manager may use different risk measures to manage the risk profile of the portfolio.

Next, the main market risk factors for options, also called *Greek letters* or simply *Greeks*, are presented. (Järvinen & Parviainen, 2014, p. 194.) Each of these risk parameters presented in Table 4 measures the different risk dimensions of the option. For example, delta Δ measures the price change Δc of an option c when the price S of the underlying asset changes slightly ΔS. Thus, the risk measure delta Δ is the first derivative of the value of the option c with respect to the price of the underlying asset S.

$$\frac{\Delta c}{\Delta S} = \frac{(c_1 - c_0)}{(S_1 - S_0)}. \tag{20}$$

Table 4. Greek letters (Passarelli 2008, p. 25, p. 50; Järvinen & Parviainen, 2014, p. 194, p. 198; Hull, 2015, p. 399).

Delta (Δ)	**Gamma (Γ)**	**Theta (ϑ)**	**Vega**	**Rho (ρ)**
Delta measures the change in the price of an option as the price of the underlying asset changes.	Gamma measures the change in the delta as the price of the undelying asset changes.	Theta measures the change in the price of an option as the maturity shortens.	Vega measures the change in the price of an option as the volatility of the underlying asset changes.	Rho measures the change in the price of an option as the risk-free interest rate changes.
The first derivative of the option price with respect to the underlying asset price.	The second derivative of the option price with respect to the underlying asset price.	The first derivative of the option price with respect to the maturity.	The first derivative of the option price with respect to the price volatility of the underlying asset.	The first derivative of the option price with respect to the risk-free rate.

The Greeks must be managed so that the risks are set at an acceptable level (Hull, 2015, p. 399). In an ideal world, financial institutions could fully manage the risk balance of their portfolios by setting all Greeks to zero. The delta can be set to zero (*delta neutral*) or at least close, but gamma and vega, for example, are considerably more cumbersome, as it is challenging to find options and other non-linear derivatives that allow trading in the desired volume at competitive prices. (Hull, 2015, p. 418.) Traders normally perform a *delta–gamma–vega analysis* with the calculations of each of these measures for every market variable to which it is exposed. The Greeks generate important data for the traders, but they do not give a way of measuring the overall exposed risk for a financial institution.

The overall risk to which the financial institution is exposed can be summarized in a single number using *Value at Risk* (VaR). This method is extensively used by financial institutions as well as fund managers and corporate treasurers. Also, regulators have been using VaR to impose capital requirements that banks have to keep for the risks they are bearing. (Hull, 2015, p. 494.) After calculating the standard deviation of the portfolio, one can use the usual VaR assumption N-day VaR $=$ 1-day VaR $*\ \sqrt{N}$ to figure out at X% certainty that the losses would not be more than V euros in the next N-days. Thus, the VaR consist of two parts—confidence level X, and the time horizon N, measured in days. However, one apparent shortcoming of the model is that the formula is just an approximation when the changes in the value of the portfolio on consecutive days do not have independent identical normal distributions with a mean of zero. (Hull, 2015, p. 494–497.)

Theories fundamentally related to the sub-components of capital-protected SIPs have now been mainly discussed. In the following chapter, the thesis moves on to the theory of SIPs. The focus is primarily on capital-protected SIPs, their theory, and practical principal-protected investing.

4 SIPs and capital protection

Previous chapters have laid the groundwork for SIPs and focused on the presentation of theories related to the sub-components of capital-protected SIPs. This chapter defines more precisely SIPs, their markets, and capital protection. Pricing is also discussed, but the presentation is concise, as the price formation of the sub-components has already been presented in the previous chapter (see Chapter 3). Finally, we review the capital-protected investment philosophy and briefly present one of the conditionally capital-protected SIPs that have become more common in the current market situation.

4.1 What are SIPs?

It is essential to be clear about the definition of SIPs, as there are a large number of different names for these products. SIPs are pre-packaged investments in the legal form of bonds that are popular among investors, enabling the investor to benefit from the favorable performance of one or more underlying assets. (Das, 2005; Jessen & Jørgensen, 2012.) The return on such products is dependent on—or at least very sensitive to—changes in the value of the underlying asset. The underlying asset can be individual stock, different indices, interest rates, commodities, currencies, or other calculated values (Deng et al., 2015).

Typically, SIPs combine a safe fixed-income component with a more risky derivative part that makes possible a positive return on the product. These products allow the investor to invest in numerous asset classes as well as adjust the level of risk to their liking. (Das, 2001: 1–5.) SIPs allow investors to invest in underlying assets that may otherwise be too expensive or even impossible to invest in (Das, 2005).

According to Järvinen & Parviainen (2014), SIPs are often the first investment vehicles that allow a retail investor to invest in new markets. The products are designed to provide investors with access to complex option and futures positions, without the need to enter those markets directly. Due to high fees and transaction costs, direct participation in the options and futures markets is disadvantageous or impossible for most investors. For this reason, SIPs can generally be said to offer a useful extension to the capital market of private investors. (Schroff, Meyer & Burghof, 2015)

SIPs can also be used to meet the needs of a wide range of investors. These investments are made with, inter alia, different maturities, underlying assets, and risk levels. (Järvinen & Parviainen, 2014, p. 29.) A common way to categorize these products is to divide them into capital-protected and non-capital-protected products (Grünbichler & Wohlwend, 2005). Both categories include vast numbers of different products, but the main focus of this thesis is on simple fully capital-protected products. An example of conditional capital protection is given due to the changed market situation, but the analysis is left narrow.

4.2 History

In the 21st century, capital-protected SIPs have become part of the portfolios of both large institutions as well as retail investors. The first SIPs appeared in 1987 in the United States (Grünbichler & Wohlwend, 2005). In the same year, *Fortune* praised the principal capital-protecting feature of SIPs, which, according to the magazine, increased the interest of a broader range of investors in the stock market (Chen & Kensinger, 1990).

In the European market, the first SIP was issued in the mid-1990s, but the number of new issues did not pick up sharply until the 21st century. (Deng et al., 2015). Demand for the SIPs originated in times of low interest rates when companies wanted to issue cheaper debt. Investors had to accept lower interest rates, but in exchange, they were given the opportunity for potentially higher returns (Yen & Lai, 2014, pp. 2–4).

One of the main drivers of the initial interest in SIPs was the opportunity for retail investors to enjoy stock market returns without the risk of losing the invested capital (SRP, 2019). In 1994, Finland's first capital-protected SIPs linked to the overall index of the stock exchange were issued. Later in 1997, the expansion of the product range to foreign stock indices significantly increased the Finnish market for SIPs, as theories and practices about the benefits of international diversification were well justified. In the 21[st] century, products with a capital protection feature have become a natural part of saving and investing. (Järvinen & Parviainen, 2014: pp. 13, 19.) Despite these factors, not much academic research has yet been done on SIPs and their performance.

4.3 Markets

The size of the global market for SIPs in 2007 was approximately EUR 365 billion, of which just over 60 % consisted of Europe and 25 % of Asia (Järvinen & Parviainen, 2014, p. 29). The Finnish market for SIPs has experienced strong growth until the end of the first decade of the 21[st] century, but sales volumes have not increased in the previous decade (Järvinen & Parviainen, 2014, p. 13).

In particular, the number of capital-protected investments has decreased significantly. This is due to low and partly negative interest rates, which prevent or complicate the formation of the capital-protected component. In a low-interest environment, credit-linked products have grown in popularity as the demand for interest-rate-linked products has fallen. Still, the sales volumes of these products have also decreased due to a reduction in the risk premium required by investors. Conditionally capital-protected products have clearly become the most significant product group. The relative focus has thus shifted towards more tailored and more risky SIPs with higher expected returns. (FSPA, 2015, 2018.)

The Finnish market for SIPs is regulated by the Securities Market Act (Arvopaperimarkkinalaki, AML), which regulates matters concerning the organization, exchange, clearing, and issuance of securities (Järvinen & Parviainen, 2014, p. 57). Generally, SIPs take the legal form of bonds, and they can be categorized in many different ways.

One typical way to describe the market for these products is to divide them into two main groups—long-term and short-term investment products. Long-term investments have somewhat cautious return and risk profiles that are in line with the underlying asset, but slightly more conservative. These products are typically medium to long-term investment strategies that retail investors utilize to implement their savings plans. Depending on their structure, these products may allow investors to benefit from both ups and downs of the market. The thesis focuses on long-term SIPs. Short-term products, as the name implies, include products designed for short-term trading. They are typically more professional, complex, and speculative leveraged strategies. (Schroff et al., 2015.)

Market participants in SIPs can be roughly divided into three groups—*issuer*, *arranger*, and *seller*. Despite this, one party can act in all roles. The issuer is responsible for the issuance of the product, establishment of the *prospectus*, and paying the potential return and capital to the investor. For these reasons, it is essential to be aware of the issuer risk and the factors that affect it. *Guarantees* are also used in some situations and products. In the case of guarantees, the investor's position is significantly improved, as the guarantor is responsible—with the issuer—for the repayment of the investment. (Järvinen & Parviainen, 2014, pp. 103–106.)

In the emission of SIPs, the arranger's role and responsibilities are significant. The transparency, timeliness, comprehensibility, and correctness of the information are the responsibilities of the arranger. The arranger is also responsible for the suitability of the product for the target group. The arranger plans, prices and prepares the necessary documentation but is also responsible for reporting, credit risk assessment, sales coordination, and the organization of the secondary market. However, these responsibilities may be transferred to other market participants through separate agreements. (Järvinen & Parviainen, 2014, pp. 103–106.)

The seller is only responsible for selling the products if it is not acting as an arranger or issuer at the same time. The same conditions regarding the target group, transparency, timeliness, comprehensibility, and correctness also apply for the seller. Customer's investment profiles determine the scope and approach of sales and marketing. For instance, marketing material for professional investors (MiFID-rated) may be more cumbersome and highly stripped-down. (Järvinen & Parviainen, 2014, pp. 103–106.)

4.4 Capital-protected SIPs

The focus is now shifting to the traditional structure of capital-protected index-linked SIPs. These products allow the investor to benefit from potential value developments in the underlying market with limited risk (Chen & Kensinger, 1990). These bond-like products enable capital-protected investments in, for instance, high-risk markets, such as currencies, commodities, or equities. (Das, 2001, pp. 1–5.)

A traditional capital-protected SIP consists of a combination of two financial instruments:

1. An interest-bearing fixed-income ZCB.
2. A call option which gives the right to buy the underlying index asset at a predetermined price within a specific time period. This right allows for virtually unlimited return potential. (Hull, 2015, p 255.)

Index-linked capital-protected SIPs, as well as other SIPs, have been on the market for decades. During this time, product development has been enormous, and countless different return and risk profiles have emerged. The market situation has played a significant role in the development of SIPs. For example, when the risk level of the underlying index is moderate, it is possible to increase the return potential.

Interest rates, which have remained low for a long time, have also had a significant impact on the ability to build attractive product packages. This is because lower interest rates simply leave less money to form the yield component of a capital-protected SIP. The return potential can be maintained in many different ways. Probably the most common ways are to lower the level of capital protection below 100% and sell above par value (at a premium).

On the other hand, as interest rates rise, the *participation rate* can be increased, as the construction of capital protection becomes more favorable. The three most common main features of a capital-protected SIP are:

1. Protection of notional principal amount.
2. Participation in the favorable value development of the underlying index with a pre-determined participation rate.
3. No guaranteed return above the level of capital-protection. (Järvinen & Parviainen 2014, pp. 121–122.)

According to Järvinen and Parviainen (2014, pp. 122–123), a typical and traditional capital-protected SIP includes the following features in addition to full 100% protection of notional principal amount:

1. Unlimited upside potential.
2. Maturity of 4-6 years.
3. The participation rate of 70–80%.
4. Issue price of about 100% of the notional value.
5. Averaging of monthly price observations in the last year.

The underlying assets of these SIPs are typically developed market stock indices, such as Nikkei 225, S&P 500, and Euro Stoxx 50 (Järvinen & Parviainen 2014, p. 123).

4.4.1 Pricing

Pricing is almost invariably of interest when studying financial instruments and their structure, but in the case of SIPs, this valuation is of particular interest. Many financial professionals have looked at fairness in the pricing of SIPs. According to Grunbichler and Wohlwend (2005), the pricing issue is of particular interest for two reasons. The first reason for the specific interest in pricing is the feature of these products that combines various financial instruments. Another reason is the potential impact of the issuer's position on pricing.

The legal form of capital-protected SIPs is typically a bond in which the issuer undertakes to repay the capital to the investor at the end of the loan period under the agreed terms (Järvinen & Parviainen 2014, p. 59). As previously noted, the riskiness of the issuer and the level of interest rates materially affect the price of a ZCB through a discount factor. This negative relationship between PV and interest rates has been discussed earlier in this thesis (see sub-chapter 3.1.2).

The capital protection part of a SIP is, in practice, an interest-bearing investment that increases by maturity on a compound interest basis to a pre-agreed level of capital protection. This feature related to the repayment of the notional amount invested has given rise to the term *capital protection*. The capital repayment is thus based on a zero-coupon fixed-income investment, which is a non-interest-bearing financial instrument issued below its FV with FV repaid at maturity.

In addition to the total repayment of the notional principal amount, a traditional capital-protected index-linked SIP promises a return on a specific degree of participation if the underlying index or indices linked to the product via call option rise from their initial level by maturity. This promise is redeemed by building a yield component using a customized index call option. The amount of money available for this yield component is determined through a ZCB. The more investors pay for a zero-coupon investment (capital protection), the less money will be left for the call option. If the issue price of a product is at 100% level (an investor pays the notional value of a SIP) and the price of the capital protection (ZCB) is 90% of the principal amount, 10% is left to acquire the yield component (index call option).

Figure 5 illustrates how—instead of a secure coupon rate—discounted coupons are invested in call option in order to increase the yield expectation. Consider an example that uses a notional principal amount of EUR 1,000, a five-year loan period, an annual fixed coupon rate of 10%, and a discount rate of 5%. It is worth noting that in today's low interest rate environment, building an attractive capital-protected SIP is very challenging.

The figures in the example are only intended to illustrate the interdependencies between the parts of the product, not to indicate the actual interest rates or the portions used for the ZCB and the yield component.

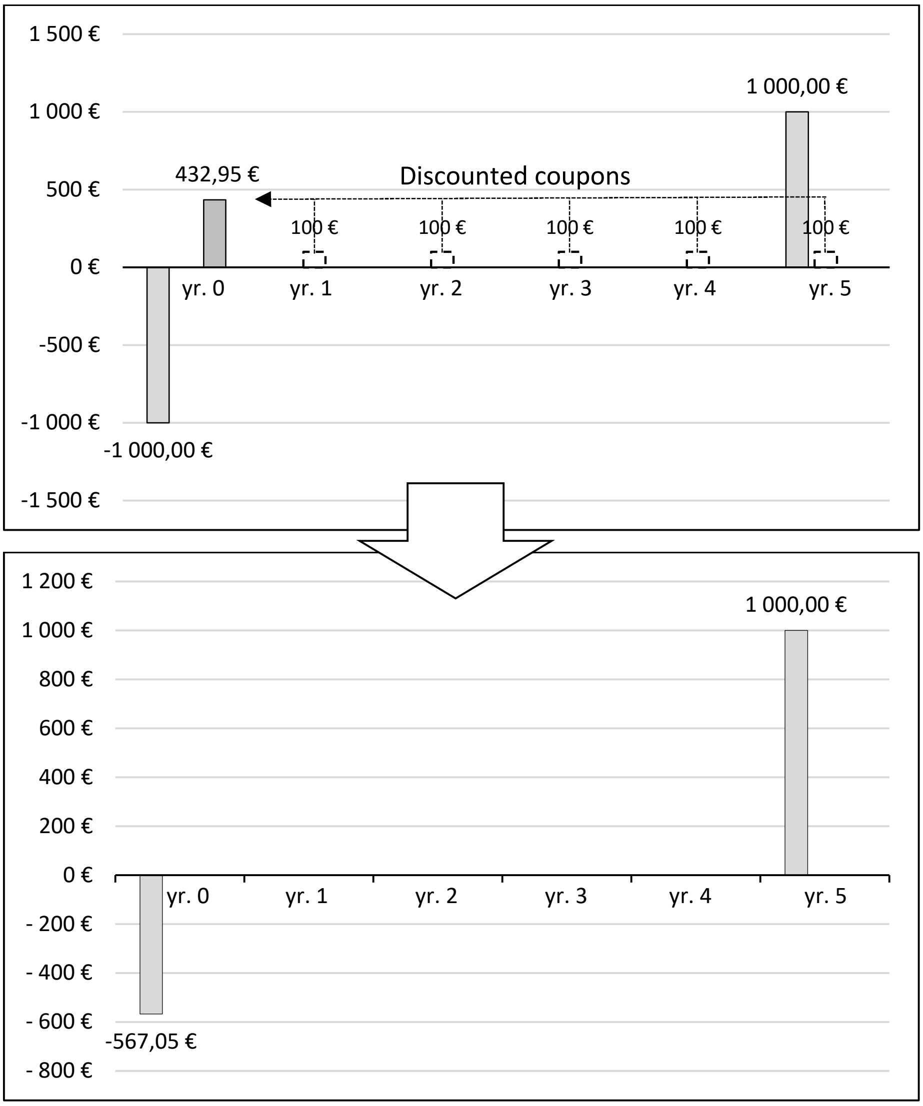

Figure 6. PV of coupons.

Figure 5 illustrates how the formula presented in the sub-chapter on *bond theory* (see sub-chapter 3.1.2. & Formula 5) calculates the PV of coupon yield, which can be used to reach a pre-determined level of capital protection by making a zero-coupon investment of approximately EUR 567.05. Therefore, in the case of the example calculation, the provider of the SIP would use the remaining EUR 432,95 to acquire a customized index call option. This option would be combined with the capital-protection component (ZCB) into an entity which is called capital-protected SIP.

The structure of a capital-protected index-linked SIP is illustrated in Figure 7. The figure summarizes the timeline and the sub-components that are essential to the structure of these products. Efforts have also been made to illustrate the formation of the potential yield and the capital protection component as clearly as possible.

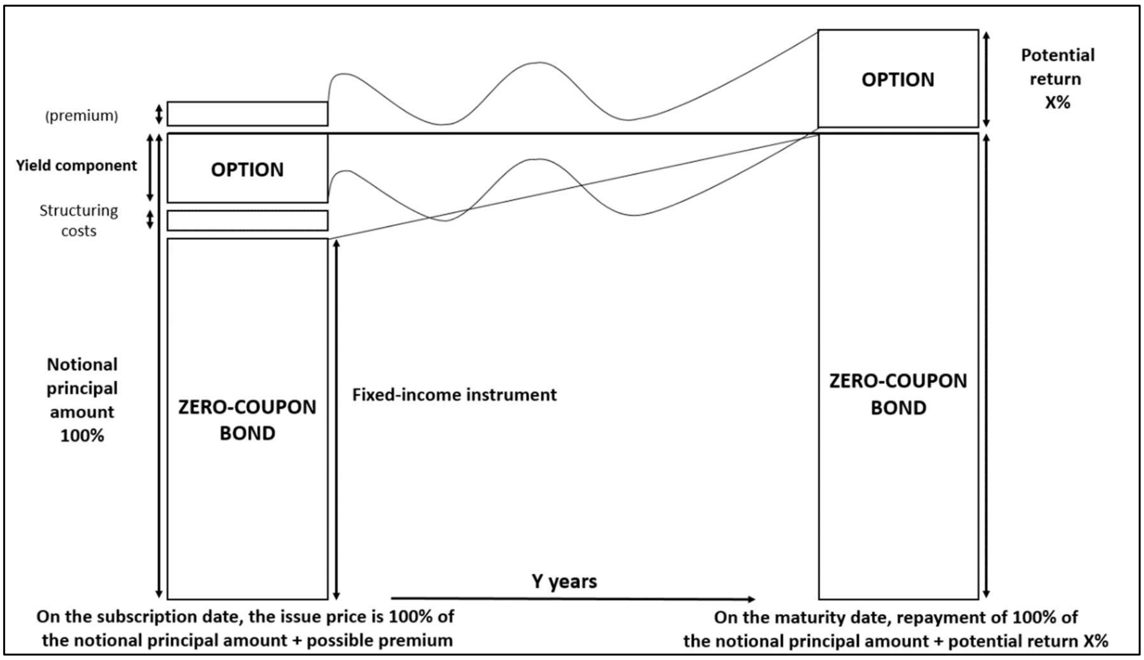

Figure 7. Structure of capital-protected SIP.

The price of the call option and the amount of money available for it determine the participation rate at which the investor can participate in the possible value development of the underlying market (Järvinen & Parviainen 2014, p. 142). For instance, with an 80% participation rate, if the value of the underlying index increases by 10%, a return of 8% is obtained.

In this case, the provider of the index-linked SIP would have purchased a call option for an 80% stake of the total amount to be issued, resulting in a participation rate of 80% on the SIP. However, if it is desired—in the case of capital protection—to obtain a full participation rate of 100% in relation to a notional principal amount, the SIP must be sold, for example, above par value (see Figure 7). When paying this premium, it should be noted that capital protection only applies to the notional value of the loan. In other words, if the return component matures as worthless at maturity, the investor loses the difference between the premium and the 100% notional value (par value). In reality, the structuring costs of a SIP provider must also be covered either from the funds used to acquire the call option or by selling at a premium. A combination of the two is also typically used. (Järvinen & Parviainen 2014, p. 141.)

4.4.2 Price formation in the secondary market

When investing in SIPs, it is essential to understand the factors that affect pricing. The secondary market valuation is affected by, inter alia, the value of the underlying asset and interest rate fluctuations. Typically, as volatility decreases, the value of already issued SIP decreases and vice versa. Lowering interest rate levels has been a positive phenomenon for those who have already invested in the SIPs. On the other hand, low market volatility has reduced this positive effect. Other parameters, such as general market dividend yield expectations and issuer risk, may also affect the price of SIPs in certain circumstances. (Järvinen & Parviainen 2014, pp. 20–21.)

The value of the index-linked SIP is formed at the time of the issue in the same way as at other future moments prior to maturity. The only difference is the stability of the index level at the time of the issue. When the value of the index or index basket changes, the changes are reflected in the value of the product. Table 5 illustrates how the value of a traditional index-linked SIP varies with different market events. (Järvinen & Parviai 2014, 131–132.)

Table 5. Effect of market events on the value of capital-protected SIPs (Järvinen & Parviainen, 2014, p. 132).

Market event	Value of SIP
Higher interest rates	-
Lower interest rates	+
Higher volatility of the underlying index	+
Lower volatility of the underlying index	-
Higher dividend yield of the underlying index	-
Lower dividend yield of the underlying index	+
Higher value of the underlying index	+
Lower value of the underlying index	-

As previously stated, the value of the index-linked SIP is significantly affected by changes in the value of the underlying asset. The intensity of the effects can be divided into three components:

1. The prevailing level of the underlying asset (index) relative to the initial level
2. The magnitude of the participation rate
3. Method for averaging the observation values of the underlying asset. (Järvinen & Parviainen 2014, p. 133.)

If the value of the SIP falls sharply immediately after the issuance, even large positive changes will not significantly affect the value of the product. For example, if the value of the underlying asset decreases significantly (80%), a substantial increase in value (500%) is required in order even to get back to the starting level (*low delta*: see sub-chapter 3.2.3.). When the situation is the opposite—that is, when the value of the underlying asset rises significantly above its starting level—changes have a very sensitive effect on value creation. For instance, when the value of the underlying asset increases by 100%, in addition to the notional principal amount, the investor gets the return of 100% times the rate of return (*high delta*: see sub-chapter 3.2.3.). Thus, the higher the participation rate, the more changes in the value of the underlying asset affect the value of the SIP. Changes in the value of an underlying asset close to maturity have a very strong effect on the value of the SIP. (Järvinen & Parviainen 2014, pp. 132–133.) Thus, it can be stated that the closer the maturity is, the more sensitive the changes in the value of the underlying index are to the value of the SIP.

The effect of the averaging method on the value of the loan depends essentially on the length of the averaging period. The shorter the time, the more sensitively the value of the SIP reacts to changes in the value of the underlying index. In this case, a single observation has a significant effect on the final value of the SIP, in contrast to the long-term averaging. The longer the average period is, the less the final value of the SIP changes as the value of the underlying asset changes.

If the averaging has not yet started, all future price observations are uncertain and depend on the current level of the underlying index. As the value decreases, the expected value of all future price observations decreases. In turn, the effect of individual price observations reduces if averaging is already underway. The longer the averaging, the more certain one can be about the final value of the SIP, as the observed prices—from which the average is calculated—are already known. (Järvinen & Parviainen 2014, pp. 134–135.) For example, in the one-year averaging method, a 10% fluctuation in the value of the underlying asset before the last monthly observation affects the final value by less than one per cent.

4.4.3 Participation rate

The most important factor related to the attractiveness of an index-linked SIP is the return factor, also called the participation rate. With a participation rate of 75%, the investor receives a return on their investment of 75% of the increase in the value of the underlying index. Typically, the participation rate is less than one 100%, but higher participation rates are possible, for example, when selling at a premium.

The participation rate is determined based on competitive and market conditions. The main factors influencing the participation rate are the interest rates and volatility (see sub-chapter 4.4.3). (Järvinen & Parviainen 2014, pp. 136–137.) As interest rates fall, the capital protection leg of the SIP becomes relatively more expensive. Correspondingly, when the rates rise, the participation rate becomes higher, as the share of capital protection in the structuring costs of the SIP decreases. In addition, when volatility levels are high, the price of an index call option used to generate index risk becomes more expensive compared to a low-volatility market.

As previously stated, structuring index-linked SIP is particularly challenging due to low interest rates. After a safe zero-coupon investment, the money may no longer be enough to form a reasonable participation rate. However, a provider of a capital-protected SIP may seek to increase the attractiveness of its products in several ways. When the market situation is challenging for structuring traditional capital protected SIPs, the product provider can use, for example, the following packaging methods:

1. Sale above par value (at a premium) (e.g., 102-105% of notional principal amount).
2. Reasonable reduction of the participation rate.
3. Longer averaging of the observation values of the underlying asset.
4. Limiting the potential return to a specific maximum percentage (e.g., 50%).
5. The underlying index follows a market with a high dividend yield or a low interest rate. (Järvinen & Parviainen 2014, p. 123.)

4.4.4 Distribution of profits and costs

The peak of the return distribution on the capital-protected SIPs is at 0%, as all negative outcomes accumulate to zero due to capital-protection. The side of positive returns is more or less normally distributed, but in absolute terms at a lower level than the stock market return distribution. This phenomenon is mainly due to capital protection, which prevents these SIPs from reaching market returns in positive scenarios. Low yields on the positive side of the return distribution are also somewhat more common than high returns, leading to a thicker distribution of returns in the middle. This thickness is mainly due to frequently used participation rates of less than 100%, averaging, and missing dividend income. Also worth noting is the negative tail risk of the capital-protected SIPs, which arises from the uncertainty related to the issuer's solvency. (Järvinen & Parviainen, 2014, p. 175.)

The price of a capital-protected SIP is usually formed as the difference between the cost of structuring and the selling price. Separate fees are typically not charged, with the exception of subscription fees invoiced by some operators. It is also worth paying attention to the number of actors in the distribution chain. The lower the number of different players involved in the distribution chain, the lower the total cost of the product. The most cost-effective solution is usually achieved by purchasing the product from a supplier who issues, builds, and sells the product from end to end. (Järvinen & Parviai 2014, pp. 145–146.)

4.5 Risks associated with SIPs

SIPs are complex financial instruments whose risks and risk weights vary significantly between products. Due to partly negative and low interest rates, the product focus has shifted towards more structured and riskier SIPs with higher expected returns (FSPA, 2015, 2018). The most common risks associated with SIPs are presented below.

4.5.1 Issuer risk

Issuer risk, also known as credit risk, is a very significant uncertainty factor for both buyers and providers of SIPs. For the former, it manifests itself through the issuer's bankruptcy risk and, for the latter, through the derivative counterparty risk. As previously noted, the issuer's risk of bankruptcy is reflected in the value of the SIP through a higher interest rate. In other words, the lower the credit rating of the issuer (see sub-chapter 3.1.3.), the higher the discount rate and thus lower the price of the bond leg, which creates capital protection.

In addition to credit ratings, there are many other ways to determine issuer risk. Efforts can be made to assess solvency by examining the issuer's financial statements, interims, prospectuses, and other documents (Järvinen & Parviainen 2014, p. 148). Altman (1968) offers a Z-model as a solution, which is used to estimate the probability of bankruptcy risk using the weighted sum of the key figures formed from the company's financial statements. Findings of market-risk premiums can also be used to draw conclusions about bankruptcy risk if the issuer has CDS or corporate loan quotations (Järvinen & Parviainen 2014, p. 148).

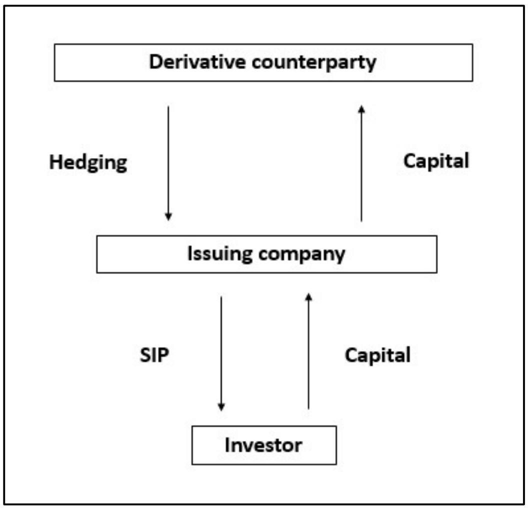

Figure 8. Process of building a SIP (Järvinen & Parviainen 2014, p. 201).

4.5.2 Market risk

SIP providers are exposed to market risk due to the derivative—such as an option—included in the product. The arranger usually hedges by entering into the counterparty risk transaction described above or, alternatively, by hedging the risk in the derivatives markets by itself. When covering market risks, the arranger body must closely monitor the so-called Greeks (see sub-chapter 3.2.3.). Elimination of risks may mean very active trading with the underlying assets. (Järvinen & Parviainen 2014, p. 193.)

4.5.3 Operational risk

In addition to the uncertainties presented earlier, operators—such as banks—have to monitor the operational risk of derivatives trading. This typically refers to risk factors related to human error and personnel. The worst realized operational risks are usually intentional misconduct. An example of this is the bankruptcy of *Bearings Bank* in which Nick Leeson caused—by fraudulent trading—nearly $ 1 billion in trading losses to his employer by failing to follow the bank's existing processes and methods (Hull, 2015, p. 18, pp. 806–807). In order to hedge against operational risk, a financial institution must carry out an active internal audit and assess the effects and probabilities of the realization of risks. Various insurances can also be used to at least partially hedge against operational risk. (Järvinen & Parviainen, 2014, pp. 202–204.)

4.5.4 Three-tier risk categories

The Finnish Structured Products Association (FSPA) has been an association established since 2005 to coordinate and improve self-regulation in the industry of SIPs. The aim is to monitor the interests of the members, to develop and maintain the public image of the market, and to co-operate with the authorities. (Järvinen & Parviainen, 2014, p. 92.) To clarify the product range, the association has developed a three-tier risk categorisation system for SIPs offered on the market. The risk categories are presented in Table 6. Each group contains different products that can be further subdivided into smaller subcategories.

Table 6. Three-tier risk categorization (FSPA 2019).

1. Capital protection (low risk)	**2. Conditional capital protection (moderate risk)**	**3. No capital protection (high risk)**
• Products offering full capital protection on maturity (if the issuer remains solvent). • Can be sold at a premium of up to 15%.	• Capital protection depending on the development of market parameters or credit events of reference companies. • For example, autocallables.	• The invested capital is of a premium nature and will not be returned under any circumstances. • The end result is often that the investment expires as worthless. • For example, warrants.

More generally, from an issuer's perspective—which is usually a bank—credit risk shows up as credit losses, market risk as reduced *net financial income* (NFI), and operational risk typically as increased *operational expenses*. However, they all lead to the same effect—reduced profit and possible losses. Expecting the losses and planning is key, but in some quarters or years, even large unexpected losses may occur. In such times, the losses might be so significant that banks do not make a profit at all, which leads to the decreasing of the bank's equity. The most extreme situation is that a huge decrease in equity leads to bankruptcy—that is, the definition of *defaulting* or *failing*. In this scenario, realized issuer risk leads to the failure of SIP capital protection, as the capital repayments to bondholders are reduced to only a fraction of the face value of the bonds (cf. Lehman Brothers subchapter 2.1.1.). Therefore, the amount of bank's equity should be adjusted so that even severe problems—such as massive credit losses, market price declines, and significant operational risk incidents—can be overcome. In addition, investors need to be aware of the issuer risk and the factors affecting it.

Logically, the banks can make more money by lending more, which leads to higher *net interest income* (NII), but also to the risk of having more substantial credit losses. Also, higher profits and higher NII can be achieved by having a smaller *liquidity reserve,* which is a backup for liquidity risk. Smaller liquidity reserve improves profitability as more money will be left for lending. Increased lending creates more money for banks since lending interest rates usually are higher than the rates paid on the assets that banks have on their liquidity reserve. Thus, if the reserve is smaller, NII is higher, but there is also a higher risk of non-survival in the case of a *liquidity squeeze*. To sum up, with less equity and smaller liquidity reserve, banks can have more income, but also more risk. This summarizing links to one of the key findings of modern financial theory—more risk, more income, and vice versa (see chapter 5).

4.6 Capital-protected investing in general

Capital-protected investing is a strategy that, in an issuer-risk-free world, can lead to a reasonable return without any risk of capital loss. Therefore, it is a very cautious investment strategy that allows the investor to sleep well at night. This sub-section briefly discusses capital-protected investing at a practical level.

The main goal of capital-protected investing is to preserve the accumulated capital. In other words, according to this investment philosophy, the most important thing is to ensure the preservation of capital over time. In addition to this, it is often desired to be able to enjoy the possible positive value development of the selected market.

Like other forms of investing, it is worthwhile for a capital-protecting investor to start by determining their own risk appetite. An investor who only desires a market interest rate as a return can invest in, for example, time deposits or short-term funds. Alternatively, slightly more risk-tolerant investors can also allocate part of their investment capital to, for instance, capital-protected SIPs. In this way, as the return expectation of the investment portfolio rises, the uncertainty of the return also increases. (Järvinen & Parviainen, 2014, p. 101, p. 103.)

When choosing capital-protected SIPs, attention should be paid to the transparency and liquidity of the underlying index asset. It is important to understand precisely what is included in the index, how the underlying components change, and what the criteria for those changes are. It is also a good idea to be aware of the known factors that affect the value of the index. Negative factors regarding expected price development include underlying indices with high dividend yield and declining *forward curve*, a high correlation between underlying indices (*index basket*), long averaging of return observations with *Asian options*, different *barrier-options*, and *yield cutters*, and the underlying market index with a lower interest rate level compared to the domestic interest rate level. (Järvinen & Parviainen, 2014, pp. 124–125; Yen & Lai, 2014, p. 25, pp. 29–30.)

In the case of a traditional capital-protected index-linked SIP, the investor should seek to find thick-tailed indices with a relatively high probability of high volatility. According to Järvinen & Parviainen (2014), this feature of the index may not always be priced into options. There have been large positive market fluctuations of this style in the technology industry and emerging stock markets, among others. (Järvinen & Parviainen 2014, p. 125.)

4.7 Different types of SIPs

The ever-increasing use of capital risk products is also attracting interest in the SIPs. As previously noted, the construction of capital-protected SIPs has been particularly challenging in recent years due to low interest rates. For this reason, the complexity of products and conditional capital protection—which depend on certain market events—have become more common. The investor may thus enjoy conditional or partial capital protection, which will be activated when pre-agreed barrier levels are not reached during the maturity. Nowadays, these conditionally capital-protected products form a large subcategory of SIPs, where the return on principal amount is a default feature, but the product can also include any risk factor depending on market conditions (Järvinen & Parviainen, 2014, p. 89). According to the three-tier risk categorization presented earlier (see Table 6), these are investment products with medium risk.

Conditionally capital-protected SIPs typically include put options sold in various forms. This product category includes, for instance, SIP called autocallable, which is built using exotic knock-in put options. Conditionally capital-protected SIPs may be well-functioning products also in various negative market situations. Studies show that in crises, the market typically overreacts to volatility, creating excellent opportunities to sell volatility. The following is a brief example of such a product, autocallable, in which the investor bears the risk in the event of a market collapse but receives reasonably high compensation for the risk she takes in a highly volatile environment. (Järvinen & Parviainen, 2014, 125.)

Compared to more straightforward SIPs—such as fully capital-protected products—complexity is associated with higher premiums (Stoimenov & Wilkens, 2005). An example of such a high-premium product is autocallable. An autocallable is a SIP—similar to a reverse convertible—that pays a high coupon rate when certain conditions are met (Järvinen & Parviainen 2014, p. 44; Deng et al., 2015). The investment period of such an investment is typically longer than that of a reverse convertible, and the capital protection is only valid if the values of the underlying assets do not fall below a specific pre-arranged barrier level during the life of the product.

An autocallable typically includes an automatic redemption clause. Thus, if the early redemption condition is met, the loan may expire before its original final maturity date. (Deng et al., 2015.) The final maturity date is typically set 4-5 years from the date of issue. The underlying asset of the autocallable may be, for instance, a basket of shares or indices, whose value development is monitored yearly on the observation date. (Järvinen & Parviainen, 2014, p. 90.)

If all the underlying assets are at the pre-determined autocall level at the observation date, the autocallable expires prematurely. Upon this redemption, in addition to the repayment of the notional principal amount, the investor will be paid—relatively high—unpaid coupon interest. Furthermore, if one of the underlying assets does not reach the autocall level by the observation date but has nevertheless fallen below the initial level by a specified percentage, the product will expire prematurely, and the investor will be paid coupon interest for that year. Moreover, if one or more of the underlying assets falls below the permitted barrier level by observation date, the investor will be left without any coupon payment for that year, and the loan will be rolled-over (extended) at least until the next observation date.

Assuming that on the final maturity date, the underlying assets have all fallen to no more than the barrier level specified in terms of the product, the notional principal amount will be returned to the investor, and a high coupon interest will be paid. The worst outcome for the investor will be realized if one of the underlying assets has fallen below the permitted barrier level by the final maturity date. In this scenario, the principal risk of the product opens and amount to be repaid to the investor is typically the difference between the notional principal amount and the impairment of the worst-developed underlying index. (Järvinen & Parviainen, 2014, p. 44, p. 90, p. 220.)

5 Behavioral finance and SIPs

This chapter provides an overview of the various theories that guide the behavior of investors. First, the traditional theories and thought patterns that dominate the literature and their assumptions are discussed. This discussion is followed by a look at more recent theories examining investor psychology. Appropriate behavioral theories are briefly presented, but the results of previous papers are used as a guideline since the purpose of this thesis is not to contribute to behavioral economics. These theories of behavioral economics question the concept of utility and preferences of traditional financial theories. Behavioral theories are related to the thesis, as they can explain the popularity of capital-protected SIPs. This popularity is irrational according to traditional theories.

One of the underlying assumptions of financial theory is that the functioning of financial markets is efficient. This efficiency means, inter alia, that prices reflect all relevant information about the financial markets. If new information appears, securities prices always respond correctly and without delay. (Nikkinen, Rothovius & Sahlström 2002, p. 80.) There are countless players in the market, and information is immediately and readily available to everyone (Knüpfer & Puttonen 2017, p. 166). The market's allocative efficiency is also complete, and investments are very liquid (Nikkinen et al., 2002, p. 80).

Market efficiency is determined by the efficient market hypothesis (EMH) developed by Fama (1970) about all information contained in stock prices. This model has been used as a basis or assumption in a multitude of studies. According to the hypothesis, the market can be effective in three different ways:

1. Weak form: only historical price information is reflected in securities prices.
2. Semi-strong: all publicly available information is factored in the prices.
3. Strong: all information—including private—is incorporated into current prices. (Fama 1970.)

According to the MPT initially developed by Markowitz (1952), a rational investor diversifies investments and maximizes the expected return, always choosing the portfolio with higher return expectation if the risk can be kept the same. Similarly, a lower risk level portfolio is selected from portfolios with the same expected return. This risk-return tradeoff is illustrated in Figure 9.

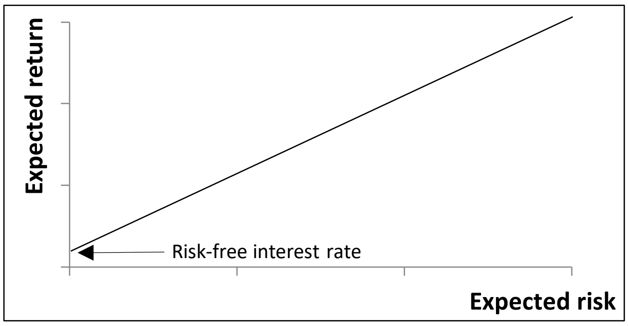

Figure 9. Risk-return tradeoff.

According to the theory, an efficient portfolio can be formed by combining several investments and thus reducing the variance and standard deviation. The more investment products in a portfolio and the closer the correlation between returns is zero, the better the risk-reducing diversification effect will work. According to Markowitz (1952), from optimal portfolios, it is possible to form the *efficient frontier* that gives a maximum return. The formation of an efficient frontier is illustrated in Figure 10.

The spheres in the figure illustrate investment portfolios with expected returns and standard deviations on the Y and X axes, respectively. It can be seen how investment options under the efficient frontier line are non-optimal. According to the theory, every rational profit-maximizing investor should move up and to the left of the figure towards an efficient frontier, to enable risk minimization and profit maximization. (Markowitz 1952; Bodie et al., 2014.)

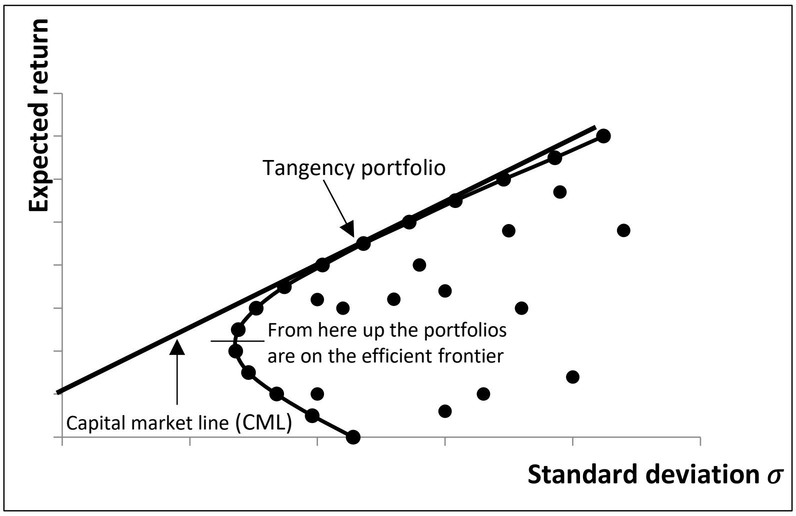

Figure 10. Efficient frontier and the capital market line (Markowitz 1952).

According to Sharpe (1964), securities prices form a linear *capital market line* (CML) at equilibrium, as also shown in Figure 9. According to the CAPM, which also describes the expected return ration and was developed on the basis of MPT, a higher expected return can only be achieved by increasing the level of risk. This model has also been named in a very well-known financial textbook as one of the seven most important ideas in the field of finance (see Brealey et al., 2014, p. 881.). The basic reality-simplifying assumptions of the CAPM are:

1. Investors are risk-avoiding, and they aim to maximize the expected return.
2. Investors are rational, and their choices are based on the risks and the returns of securities.
3. All investors invest in the same investment period, and their expectations on the return and the risks to the securities are homogeneous.
4. There is perfect competition in the market, so it is impossible for individual investors to influence the price levels. Information is also available free of charge to all parties at the same time.
5. Investors can borrow and lend indefinitely at the risk-free interest rate.
6. Investments can be divided into infinitesimal parts, and they are completely liquid.

7. There are no imperfections in the market, such as taxes and restrictions that could prevent securities from being sold short.
8. All investments are fully divisible and marketable. (Bodie et al., 2014; Malkamäki & Marikainen, 1989, p. 83; Nikkinen et al., 2002.)

Combining the theories of Markowitz (1952) and Sharpe (1964) in Figure 10, one can illustrate the axiom that a point hitting the tangent of a CML is theoretically efficient. This tangency portfolio also has the highest Sharpe ratio. In order to achieve a higher return, the investor must increase the level of risk. The latter is one of the key findings of modern financial theory.

The models and theories presented above focus on explaining optimal investment behavior while making many drastic simplifications. Investors are seen as effective risk-adjusted return-maximizing rational individuals whose choices are not influenced by a lack of information, understanding, or computing skills. According to Brealey et al. (2014, p. 328), early researchers have almost invariably believed Fama's (1970) EMH to be a remarkably good description of reality. According to the researchers, the empirical evidence in favor of the hypothesis has generally been so strong that all studies questioning it have been viewed with great doubt. However, the hypothesis and other basic theories have received much criticism. Several empirical findings on anomalies have been found, such as those related to market inefficiency and choices under uncertainty. Through this questioning, several studies have emerged that proved the existence of anomalies. (Brealy et al., 2014, p. 328.)

As previously noted, according to the EMH, the information efficiency of financial markets is based on the assumption that prices react to new information as it emerges. The inclusion of such data in securities prices requires two things. First, investors must have access to all information relevant to the prices of securities (*information supply*). Second, investors must take into account all price-relevant information (*information demand*) to and take it fully into account in economic decision-making. (Schroff et al., 2015.) Given the ever-increasing flow of information in financial markets, such assumptions seem at least questionable.

In today's *information economy*, paying attention to the relevant information has become a scarce cognitive resource. This scarcity applies to all types of investors, but especially to retail investors, who typically do not have sufficient time and resources. Therefore, information cannot be claimed to be included in asset prices until all investors have considered all price-relevant information. (Schroff et al., 2015; Kahneman & Tversky, 1979.) From this argument, it can be concluded that information efficiency cannot be true.

Because of the numerous simplified assumptions, traditional financial theories can be criticized for being unrealistic in describing many choices. The following sub-chapter will move on to address behavioral research that offers alternative outcomes and perspectives on investors as limited rational actors that do not function completely rationally from the frame of reference of traditional theories.

5.1 Behavioral finance

Behavioral economics is a field of microeconomics that consists of cognitive psychology and the constraints of arbitrage that can attempt to explain market inefficiencies. Cognitive psychology is used to search for psychological regularities and observations that can be used to model behavior that deviates from rationality. These regularities, which deviate from traditional rationality, tend to be transferred to the investment choices of humans. The limitations of arbitrage relate to the mispricing of securities and the fact that assumptions about traditional financial textbook theories of perfect markets and pure arbitrage cannot, according to behavioral theory, be realized in the real world. (Knight, 2003; Hyytinen & Maliranta, 2015.)

One of the most important assumptions about behavioral economics is the limited rationality of the actors. This refers to the actors' limited ability to understand their own behavior and their environment. (Hyytinen & Maliranta, 2015.) Therefore, the concept questions the EMH assumptions about the actor's unlimited cognitive abilities and information efficiency. Limited rationality can be used to describe, inter alia, investor decision-making in a situation where, despite their reasonable efforts, they cannot find optimal choices.

According to Kahneman and Riepe (1998), investor choices are guided by preferences and beliefs. Choices are regarded as risk-taking in the decision-making process due to the uncertainty associated with the result. According to the researchers, investors make choices by giving them probability weights, which are significantly affected by the investor's own beliefs and preferences about risk appetite. Behavioral economics has created many models that can also be used to describe investment behavior. The following are some definitions of systematic investment distortion presented by Ritter (2003)

1. *Heuristic*: rule of thumb that simplify decision-making, which may also lead to negative outcomes. Heuristic behavior refers to the above-mentioned way for investors to weight alternatives with probabilities.
2. *Mental accounting bias*: at the mental level, the investor internalises the money to belong to different accounts, and decisions are made independently of these mental accounts. For example, the amount of money received as a gift or tax refunds is perceived to be easier to waste than that earned through hard work. However, this mental accounting leads to choices that are questionable in investment activities as a whole.
3. *Anchoring*: investors anchor themselves in the first observation, as they tend to make this state the norm and compare, for instance, their investment returns with the previous state (*status quo*).
4. *Overconfidence bias*: investor's excessive self-confidence in their own abilities, which is manifested, for example, in too little investment diversification. The overconfidence bias is also revealed in high trading volume and exposure to overweight on secure investments, such as investments in well-known domestic companies or capital-protected SIPs.

5. *Framing effect*: investors behave differently depending on how the investment opportunity is presented.
6. *Disposition effect*: investors usually sell their holdings faster at a higher price compared to investments that are at a loss. This effect is reflected in the reduced trading volume in the bear market and the increased trade in the bull market.
7. *Gambler's fallacy*: the investor's erroneous belief that completely independent events are interrelated. A classic example of this is coin tossing.
8. *Representativeness*: investors overweight short averages and give excessive weight to long-term averages. This bias occurs, for instance, when an investor makes investment decisions based on recent information.

The utility functions of investors vary due to different preferences. Preferences of investors are often divided—when talking about perceived utility—into risk-averse, risk-neutral, and risk-seeking preferences. The utility function of risk-averse investors is concave. This kind of investor wants to ensure the preservation of capital. They invest safely, for example, in deposits, even though the weak long-term return expectation is already known. (Järvinen & Parviainen, 2014, p. 183). The risk-averse investor requires a higher risk premium compared to the risk-neutral and risk-seeking investors. For example, a capital-protected SIP can be an optimal investment vehicle for a risk-averse investor who wants to take the opportunity to get involved in potential positive market developments.

The utility functions of risk-seeking investors are convex. These kinds of investors want to maximize the expected return in the long run and are willing to bear the risk of a total loss of capital. Significantly riskier products are suitable for investors with this type of preference. A suitable investment vehicle may be, for example, a collateralized debt obligation (CDO), which includes, in addition to issuer default risk, the credit risk of the companies in the reference portfolio. (Järvinen & Parviainen, 2014, p. 188).

There are many types of investors, but traditional expected utility based financial theories assume investors to be risk-neutral. Risk-neutral investors have preferences that are neither risk-seeking nor risk-averse. In this case, the investor is assumed to be indifferent between investment choices with equal return expectations. Investors assess their gain and loss perspectives symmetrically (see Figure 11), and, for instance, the pain of losing EUR 1 Million can only be compensated by the pleasure of gaining EUR 1 Million. Figure 11 below illustrates this *linear utility function* of a risk-neutral investor. Contrary to the assumptions of traditional financial theories, recent research has shown that the majority of investors belong to the risk-averse group. (Kahneman & Tversky, 1979; Järvinen & Parviainen, 2014, pp. 186–187.)

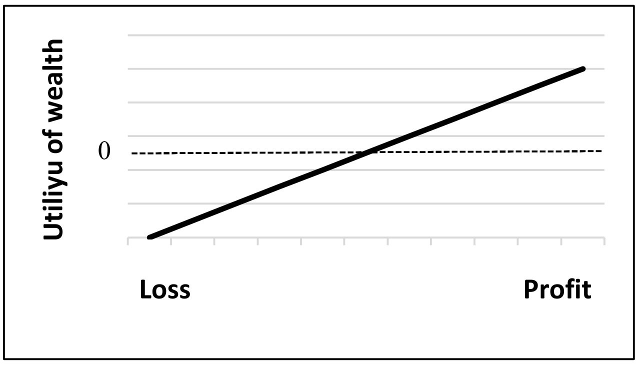

Figure 11. Linear utility function.

5.2 Prospect theory

The following sub-chapter presents the basics and main discussions of the prospect theory developed by Kahneman and Tversky in 1979. The theory describes several classes of choice problems in which the preferences of individuals systematically violate the axiom of the theory of expected utility. Based on the research findings, it is concluded that the *expected utility theory*—as it has often been interpreted and applied—is not a sufficiently valid descriptive model. The offered model comes from prospect theory, which is an alternative way of modeling choice under uncertainty. The purpose of the theory is thus to describe an individuals' behavior in risky decision-making situations. In addition to the expected utility theory, criticism is also directed at the general paradigms prevailing in economics. (Kahneman & Tversky, 1979.)

The study of Kahneman and Tversky was from 1975 to 2000, the second most referenced paper in all economics and the best known of the publications related to behavioral theories (Zhang & Gonzalez, 2004). The much-debated research in academia was continued in 1992 when Tversky and Kahneman (1992) published an updated version, the *cumulative prospect theory*. The results obtained from both studies contradict the expected utility theory.

Studies show that people underweight outcomes that are likely compared to outcomes that are certain. This phenomenon is called the *certainty effect*. According to the phenomenon, the decision-maker avoids risk in a situation involving certain returns and seeks risk in a situation involving certain losses. According to the results, when making a profit, the majority of people are risk-averse. Still, when the possibility of a loss arises, people become more risk-seeking. Such a change in preferences based on psychology also materializes with the same investment options when the sign of the monetary gains of the prospects—that is, the possible future states—changes to minus. According to the researchers, this phenomenon, called the *reflection effect*, manifests itself in peoples' preferences at the zero point of gains and losses. However, the study by Tversky and Kahneman (1992) points out that prospect theory does not require full reflection as profits turn into losses corresponding to their magnitude. (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992.)

The expected utility theory may also be broken by the fact that people usually simplify decision situations with different options by ignoring the elements that connect prospects and focus on the components that differentiate them from each other (Tversky, 1972). This approach to the decision under risk leads, according to the researchers, to inconsistent preferences because potential choices can be decomposed into components that connect and differentiate them in more than one way. These different approaches sometimes lead to different preferences. The phenomenon is called the isolation effect or The von Restorff effect. According to the general definition of the phenomenon, if several homogeneous stimuli are presented to a decision-maker, she is more likely to remember the stimulus that stands out from the homogeneous set. (Parker, Wilding & Akerman, 1998.)

According to the underlying assumption of *rational choice theory*, choices should be consistent with the options presented. Imagine a situation where a doctor tells a patient about serious illness for which the best chance of surviving is a somewhat risky surgery. According to the theory of rational choice, it is completely irrelevant whether the physician states that the probability of a fatal complication is 25 per cent or that the likelihood of survival is 75 per cent. The only difference between the scenarios is the way the information is organized in the patient's mind. However, research has shown that the way information is presented has significant, consistent, and predictable effects on an individual's decision-making process. (Kahneman & Tversky, 1979.)

One of the most important features of prospect theory is the reference point, which is used to look at gains and losses. This reference point is the starting point for an assessment, understanding, or comparison in a decision-making process. It is the prevailing state (status quo), which refers to the point of reference from which decision-makers consider changes in the value of their assets when risk prevails. (Kahneman & Tversky, 1979.) The lack of good reference points causes problems, as gains and losses are often experienced through reference points. The loss aversion and *endowment effect* are both psychological effects related to reference points.

An analysis based on changes in the wealth allows gains and losses to be taken into account regardless of total wealth. This approach also differs from the expected utility theory, where changes in wealth are viewed precisely through total wealth. According to the prospect theory, the value experienced when moving away from the reference point is formed as the change caused by gains and losses. (Tversky & Kahneman, 1992.) The decision between different prospects is mathematically experienced as follows:

$$max\ E[v(\Delta W_t)] = max\ E[v(W_t^T - W_t^R)], \quad (21)$$

where

$v =$ utility of the choice

$W_t =$ initial wealth

$W_t^R =$ reference point to which the change in wealth in situation W_t^T is compared. (Barberis & Xiong, 2009.)

According to the prospect theory, particularly a sudden decline in wealth causes an increase in risk-seeking when a new state of loss has not yet been experienced as the prevailing state (status quo). In addition, the increase in profit from EUR 50.00 to EUR 100.00 seems to be greater for investors than the increase in profit from EUR 550.00 to EUR 600.00. (Kahneman & Tversky, 1979.) This cognitive bias is due to the declining perceptual capacity, according to which the perceived effect of change decreases as one moves further away from the reference point. (Tversky & Kahneman, 1992.)

Kahneman and Tversky (1979) seek to replace the linear utility function of a traditional risk-neutral investor with the utility function of prospect theory. This non-linear value function is shown in Figure 12 (cf. Figure 11). The function aims to illustrate the perceived utility of both gains and losses. The vertical axis of this two-dimensional graph depicts the subjective utility perceived by the investor, while the horizontal axis depicts the objective returns. The graph is generally concave for gains and convex for losses. (Kahneman & Tversky, 1979.)

The graph that makes up the function—whose reference point is at the origo—can be said to resemble the shape of the letter S. The utility function describes the general principles of prospect theory—loss aversion, reflection effect, and the *diminishing sensitivity* to price changes. The loss aversion is observed at the steeper point of the function to the left of the reference point. The shape depicting the profits to the right of origo is much more gently sloping. Thus, the utility from the profits is perceived to be significantly less than the disutility generated by a loss of the same magnitude.

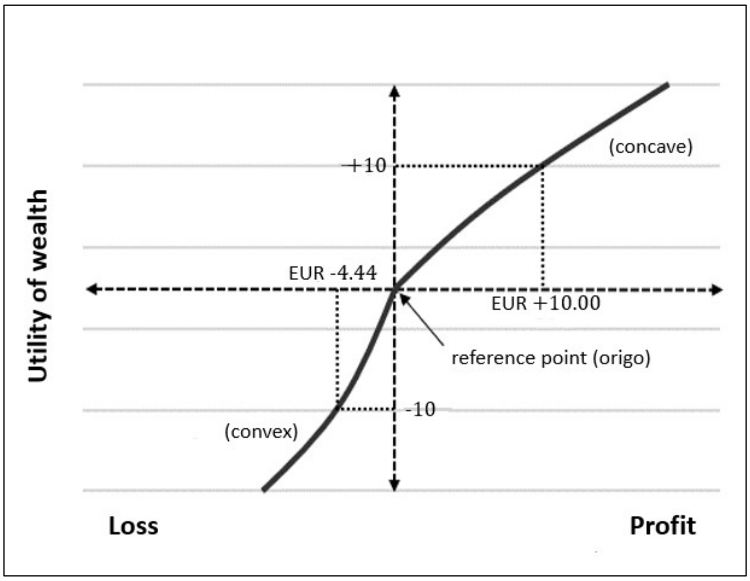

Figure 12. Prospect theory utility function (Kahneman & Tversky, 1979).

In their study, Tversky and Kahneman (1992) prove that losses are valued to be 2.25 times stronger than gains of the same magnitude. It can be concluded from this that an investor chooses a prospect with an equal chance of profit and loss only if the profit is at least about twice the loss. On the other hand, as losses increase, the profits that offset them must more than double.

The reflection effect also stands out from the utility function, which manifests itself in the avoidance of risks in the case of profits. According to the theory, it is much more sensible for an investor who avoids losses to redeem profits than to continue risking them. This logic explains the increasing risk-aversion to the right of the reference point (origo). In contrast, the steep form of the utility function in the side of losses encourages the investor to offset the losses by taking excessive risks, as this may compensate for the large loss previously caused. The observed phenomenon also has a negative effect on investors' willingness to realize unprofitable investments. (Kahneman & Tversky, 1979.)

In addition, figure 12 illustrates the aforementioned diminishing sensitivity to prices as a decreasing change in the utility of wealth as the price moves further away from the reference point. (Barberis, 2013). Thus, the perceived utility of both gains and losses decreases as the value of the asset moves further away from the origo. The function describing the value can also be expressed mathematically as follows:

$$V(x) = \begin{cases} x^{\alpha}, if\ x \geq 0 \\ -\lambda(-x)^{\beta}, if\ x < 0' \end{cases} \tag{22}$$

where

x = the value of the outcome

α = coefficient for risk-aversion

β = coefficient for risk-taking

λ = coefficient for loss aversion. (Tversky & Kahneman, 1992.)

According to Tversky and Kahneman (1992), the parameters α and β are 0.88, which manifests itself as a diminishing sensitivity and causes a curved shape of the value function. Loss aversion is already described by the above-mentioned value λ = 2.25. Investor irrationality and diminishing sensitivity can also be explained by the probability weighting functions developed by Kahneman and Tversky, which are shown in Figure 13 below.

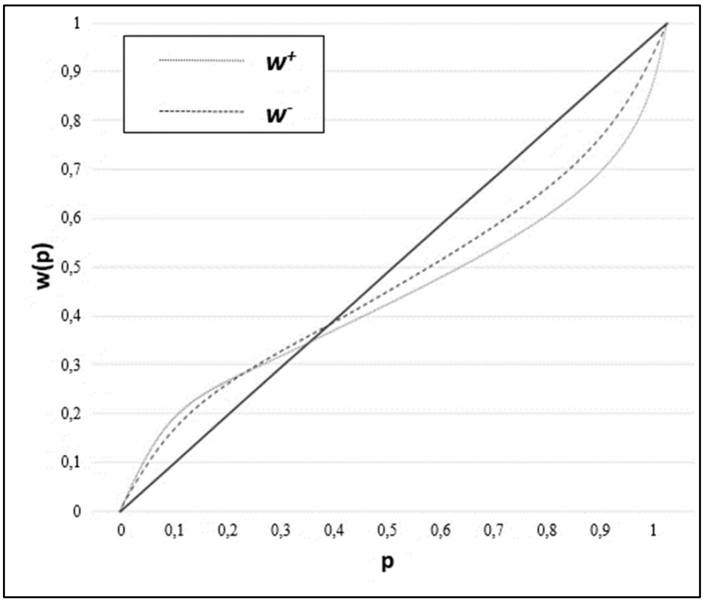

Figure 13. Probability weighting function for profits (w^+) and losses (w^-) (Tversky & Kahneman, 1992).

It can be seen from Figure 13 how the changes in probabilities are experienced more strongly closer to the extreme values. In the mid-range of the probabilities, the situation is quite different. Increasing the probability by 0.1 from 0.9 to 1.0 or zero to 0.1 seems to be experienced significantly stronger than an increase in probabilities from 0.5 to 0.6. (Tversky & Kahneman, 1992.)

Based on prospect theory and other psychological heuristics, it can be said that the majority of individuals who save and invest belong to a group of people who experience losses and profits asymmetrically in their utility functions. For the investor with such an investment profile—where the utility function forms non-linearly—a capital-protected SIP may be an optimal investment option.

6 Data and methodology

This chapter explains how the research hypothesis is tested empirically. The null hypothesis suggests that there are no return performance differences between stock indices and capital-protected SIPs. More precisely, the aim is to examine the five-year performance in the market-adjusted framework by investigating the overall performance of SIPs with a five-year tenor. In order to test the research hypothesis, comprehensive comparisons are made for all products in the whole sample as well as for the different portfolios by using appropriate stock market indices as a market portfolio.

This chapter incorporates three sub-chapters. Firstly, the data collection process is described shortly. In the second sub-chapter, the data used in the empirical part of the study is described in more detail. Also, the classification of SIPs into portfolios is briefly described. Thereafter, the research methodology that is employed to test the return performance of SIPs is explained in a more detailed manner. Two different market-adjusted methods—market-adjusted abnormal returns method, and market-adjusted long-run wealth relatives method—are used.

In both methods, the Student's (1908) t-test is employed to determine whether the null hypothesis holds true for all the products as well as for the different product portfolios. The t-test for one-sample is utilized in order to test if the mean abnormal returns differ statistically significantly from zero. In addition, the t-test for two-sample assuming unequal variances is employed to test the equality of means between different portfolios. This way, also the possible statistical differences between the mean abnormal returns of SIPs with different underlying stock indices can be analyzed.

The research hypothesis is also tested with two non-parametric methods. The Wilcoxon's (1945) ranked-sum test is used to test if the median abnormal returns differ significantly from zero. Also, the equality of medians between portfolios is tested with the Wilcoxon–Mann–Whitney rank test. By doing this, the possible statistical significance of differences between the median abnormal returns of SIPs with different underlying stock indices can be tested.

The observation period spans the time from 2010 to 2019. The return on SIPs is often tied to price indices because the OTC market for those indices is significantly more liquid than for the TRIs. The return characteristics of the SIPs in the thesis are compared to the appropriate equity market indices. Indices used in comparisons are TRIs of Euro Stoxx 50, OMX Nordic All-Share, and OMX Helsinki. These types of total return indices are chosen because an investor would receive dividends if she decides to hold all the shares of firms in the index or, alternatively, buy an *exchange-traded fund* (ETF) that tracks the index.

Euro Stoxx 50, OMX Nordic All-Share, and OMX Helsinki have been selected to reflect stock market returns, as the sample of SIPs used in the thesis is allotted into three portfolios based on the underlying assets of the products. The comparison between the performance of capital-protected SIPs and indices proxying equity market returns is made in order to see the return differences between the two different passive investing strategies during the observation period.

6.1 Data collection

The data related to SIPs is collected from *Danske Bank* via e-mail. Danske was the only bank that agreed to cooperate. The first set of e-mails designed for the respondents contained data collection requests related to a variety of research problems and SIP categories. The main idea was to survey the availability of the data and the willingness of banks to cooperate. After the first round, discussions were actively pursued, and further questions were raised.

First, all the bankers in the target group were approached with the same message containing questions about the bank's interest in various topics related to SIPs. In the second stage, more specific questions were raised regarding the availability and the amount of the data. These e-mails mainly included questions about the costs of building SIPs, and how the prices have evolved and developed in the primary and secondary markets. Such questions were formulated to be as understandable as possible. The aim was to raise the banks' interest in the research topic as well as to gather as much information as possible.

The material provided by the bank included the returns on invested notional principal capital and the final term prospectuses of 176 fully capital-protected SIPs. The returns on invested notional capital have been confirmed with the option counterparty and paid to the investors. Research based on this return data aims to provide unique and valuable insights and support in drawing general conclusions about the performance of fully capital-protected SIPs issued in Finland.

6.2 Data description

The data used in this empirical analysis includes 39 fully capital-protected SIPs issued and expired between 2010 and 2019. The original data set consists of 176 fully capital-protected investment products. However, in order to conduct a sensible study, the sample that is used in the thesis excludes 137 products due to radical differences in terms of underlying assets, maturities, degree of participation rate, issue prices, and data unavailability.

As mentioned before, only the return data in terms of return on notional capital of the products was provided. However, the provided prospectuses could also be used to derive a *holding period returns* (HPRs) of each product for the entire invested capital. These calculations will be explained later in this chapter.

Return data for the TRIs of Euro Stoxx 50 (*DJES50I(RI)*), OMX Nordic All-Share (*OMNASHE(RI)*), and OMX Helsinki (*HEXINDX(RI)*) is obtained from *Thomson Reuters*. Euro Stoxx 50, OMX Nordic All-Share, and OMX Helsinki have been selected to proxy equity market returns as the SIPs—used in this study—are divided into three different categories based on the underlying assets they contain.

6.3 Classification of SIPs into portfolios

In the thesis, SIPs are classified into three different categories. This method is used to interpret the return performance as well as performance differences between different fully capital-protected index-linked products. Classifications into (i) *Europe*, (ii) *Nordic*, and (iii) *Finland* portfolios is done according to underlying assets of each SIP. The 10 products whose underlying asset is an index following European stocks are included in the Europe portfolio, while the 16 products whose underlying assets is an index tracking stocks from the Nordic countries are included in the Nordic portfolio. The third portfolio is called Finland, and it consists of 13 products whose underlying asset is an index that tracks the shares of 36 large publicly-traded Finnish companies. In addition, statistics for all 39 products are also reported, and the fourth formed portfolio is called (iv) *All*.

Because of this classification, in order to make a sensible comparison, three aftermentioned TRIs have been selected to proxy equity market returns as benchmark indices. The TRIs are Euro Stoxx 50, OMX Nordic All-Share, and OMX Helsinki, as they follow European, Nordic, and Finnish stocks, respectively. Logically, the Europe portfolio is compared to the Euro Stoxx 50, the Nordic portfolio to the OMX Nordic All-Share, and the Finland portfolio to the OMX Helsinki. A statistical comparison of all 39 products in the whole sample has also been made by comparing it with the Euro Stoxx 50 TRI, as the underlying stock indices of all SIPs in the whole sample are tracking stocks from the European countries.

As can be seen, one of the limitations of the empirical part of the study is, unfortunately, the tiny number of SIPs in the sample. The distribution of products is also unevenly distributed in terms of issues. These are due to the previously mentioned poor availability of data and the fact that the issuances of new capital-protected products have decreased substantially due to low interest rates (FSPA, 2015, 2018). Because of these reasons, research results should be interpreted with some caution.

6.4 Methodology

The thesis focuses on the return performance of SIPs with 100%-level of capital protection combined with a stock index call option. The return characteristics are compared to those of the suitable stock indices. SIPs investigated in the thesis are approximately five-year products. The thesis relies on two main approaches to measure the performance of the SIPs. These two different market-adjusted long-run methods are presented in the following sub-chapters.

6.4.1 Market-adjusted long-run abnormal returns

In order to calculate the market-adjusted abnormal returns (ARs) for SIPs, the HPRs for each product needs to be computed. The formula is presented below.

$$HPR_{i,t} = \prod_{t=1}^{T}\left(1 + r_{i,t}\right) - 1, \tag{23}$$

where

$HPR_{i,t}$ = is the holding period return for product i in period t

$r_{i,t}$ = the return for product i in period t

Due to the somewhat cumbersome data provided for the thesis, other means are also needed in order to calculate HPRs. The total percentage return HPR_{it}—received from holding each SIP over its lifetime—is derived from the product-specific returns on the notional amount. The issue prices and redemption amounts used in the HPR calculations have been hand-collected from the final term prospectuses of each product. The total return on a notional amount has been converted to HPR by using the following formula.

$$HPR_{i,t} = \frac{\left(1 + P_{i,t} - I_i\right)}{I_i}, \tag{24}$$

where

$HPR_{i,t}$ = the holding period return for product i in period t

P_{it} = the total return on the invested notional capital for product i in period t

I_i = the issue price in percentages for product i in period t.

The reason why the return on the notional principal amount is not the same as the return on the entire invested capital is that some products are issued out at a premium. In other words, the issue price has been above par value (>FV) of a ZCB. This premium payment means that investors have had to pay more than the capital-protected notional principal amount for the investment. This issue has been discussed earlier in the thesis in sub-chapter 4.4.

In addition, the HPRs of the thesis are subject to different time periods, and the total age of the products in the whole sample has varied slightly between 1839 and 1877 days. As a result of this, there is little unreliability, and the results should be interpreted with some caution. Despite the small variations of the days, the SIPs—used in the thesis—are said to have a five-year tenor. However, as previously stated, the comparisons to the TRIs are reliable because the returns of each TRI have been collected from the same time period as the comparable SIP has been on the market. That is, the HPRs for the market indices have been computed for the period between the issue date and maturity date of the comparable SIP.

The AR for each SIP is simply calculated by taking the difference between the return on the SIP and the return on the appropriate stock market index in the same time period. AR is expressed as follows.

$$ar_{i,t} = HPR_{i,t} - r_{m,t}, \tag{25}$$

where

$ar_{i,t}$ = the abnormal return for product i in period t

$r_{m,t}$ = the corresponding market portfolio return.

Subsequently, equally-weighted mean ARs are reported separately for the Europe, Nordic, and Finland portfolios as well as for the complete sample of 39 SIPs (“All”). This is done in order to interpret the return performance of different product portfolios. The equally-weighted means are expressed as follows.

$$AR_{p,t} = \frac{1}{n_{p,t}} \sum_{i=1}^{n_{p,t}} ar_{i,t}, \tag{26}$$

where

$AR_{p,t}$ = the mean abnormal return for the portfolio p in period t

$n_{p,t}$ = the number of i products in the portfolio p in period t

Finally, it is measured whether $AR_{p,t}$ differ statistically significantly from zero by using the Student's (1908) t-test.

$$t = \frac{AR_{p,t} - 0}{s_{p,t} / \sqrt{n_{p,t}}}, \tag{27}$$

where

t = the Student's t-statistic

$s_{p,t}$ = the sample standard deviation of the abnormal returns in the portfolio p in period t, calculated by using the *n-1 method*. The formula is presented below.

The sample standard deviation assumes that the data is a sample of the population. This is the right method as the data by no means covers the entire population. Calculations have been made by using the n-1 method, as presented below.

$$s_{p,t} = \sqrt{\frac{\sum \left(ar_{i,t} - \overline{AR_{p,t}}\right)^2}{n_{p,t} - 1}}, \tag{28}$$

Statistical significance is denoted with *, **, and ***, indicating significance at levels of 10%, 5%, and 1%, respectively. The conclusion chapter reports both the p-values and the t-statistics in the result tables.

Furthermore, medians are calculated and reported, as the mean does not always give a fair picture of the data. This is due to possible outliers. The relatively larger or smaller values the data set contains, the more it affects the average. In contrast to the mean measure, the median is a measure that indicates the center of a numerical dataset. Therefore, it reasonably fulfills the objective of measuring the central tendency of the data.

In the case of this study, the null hypothesis is that the median measures are statistically zero. This hypothesis is tested by Wilcoxon's (1945) ranked-sum test, and the p-values for medians are also shown in the result tables. Both median and mean tests have been performed under the assumption of independence.

In order to compare the equally-weighted mean ARs between the Europe, Nordic, and Finland portfolios, an independent Student's two-sample t-test for unequal variances and sample sizes is employed to test whether there is statistical equality of differences in means. In other words, the method tells whether the differences—measured in means—could have happened by chance. For example, if $AR_{p_1,t}$ and $AR_{p_2,t}$ are the mean ARs, respectively, for the Europe and Nordic portfolios, then the Student's two-sample t-statistic for those portfolios can be computed as follows.

$$t = \frac{(AR_{p_1,t} - AR_{p_2,t})}{\sqrt{\left(\frac{s^2_{p_1,t}}{n_{p_1,t}} + \frac{s^2_{p_2,t}}{n_{p_2,t}}\right)}}, \tag{29}$$

where

$s^2_{p,t}$ = the sample variance of the abnormal returns in the portfolio p in period t, calculated by using the previously explained n-1 method.

Moreover, the statistical equality of medians—between the equally-weighted ARs between the Europe, Nordic, and Finland portfolios—has been tested by using the non-parametric Wilcoxon–Mann–Whitney rank test with *Yates continuity correction* factor and *ties correction*. Both corrections only apply to the normal approximation. Also, the test is done under the assumption of independence.

6.4.2 Market-adjusted long-run wealth relatives

The wealth relatives (WRs) have been chosen to be the second market-adjusted method for measuring SIP returns in the long-run. In the thesis, it is intended to measure the TR from a buy and hold strategy where a capital-protected SIP is purchased at the time of issue and held until maturity.

To be able to interpret the total HPR, the overall returns of each SIP and their benchmarks are equally-weighted. Following, e.g., Ritter (1991), Spiess and Affleck-Graves (1995), Loughran and Ritter (1995), Brav, Geczy and Gompers (2000), Alvarez and Gonzalez (2005) and Hahl, Vähämaa and Äijö (2014) WRs are computed as a performance measure. The WRs are utilized to measure market-adjusted SIP returns in the long-run (five-year period). This performance measure, $wr_{i,t}$, for each SIP i from time $t = 1$ to T is defined as:

$$wr_{i,t} = \frac{\prod_{t=1}^{T}(1+r_{i,t})}{\prod_{t=1}^{T}(1+r_{m,t})}, \tag{30}$$

where

$wr_{i,t}$ = the wealth relative for product i in period t

$r_{i,t}$ = the holding period return on the product i in period t

$r_{m,t}$ = the corresponding market portfolio return.

The WR method has been widely used when studying market-adjusted returns for *initial public offerings* (IPOs) in the short-run and long-run periods. The best-known studies on the subject have been conducted by Ritter (1991), Brav et al. (2000), and Álvarez et al. (2005).

The WRs do not have the same disadvantage with, for example, the *cumulative abnormal returns* (CARs) method, because WRs accurately reflect the wealth effect on an investor. This is because of the fact that the WRs take into consideration the compounding returns. In addition, CARs assume the frequent rebalancing of the portfolio. Therefore, the advantage of using the WRs when examining the market-adjusted ARs for both IPOs and SIPs is that WRs are an exceptionally straightforward measure to interpret. A WR with a greater value than 1.00 is interpreted as the SIP outperforming the market portfolio. In contrast, a WR with a value under 1.00 suggests that a SIP is outperformed by the market.

For the null hypothesis to hold true, the WRs should average to unity. This follows that the average of $wr_{i,t}$ for each product should equal to one. The following formula shows how the equally-weighted mean WRs have been computed for each portfolio.

$$WR_{p,t} = \frac{1}{n_{p,t}} \sum_{i=1}^{n} wr_{i,t}, \tag{31}$$

where

$WR_{p,t}$ = the mean wealth relative for the portfolio p in period in period t

$n_{p,t}$ = the number of i products in the portfolio p in period t.

Finally—similarly to market-adjusted ARs—it is measured whether the portfolio WRs differ statistically significantly from 1.00 by using the Student's (1908) t-test.

$$t = \frac{WR_{p,t} - 1}{s_{p,t} / \sqrt{n_{p,t}}}, \tag{32}$$

where

t = the Student's t-statistic

$s_{p,t}$ = the sample standard deviation of the wealth relatives in the portfolio p in period t, calculated by using the n-1 method.

As discussed earlier, the sample standard deviation assumes that the data is a sample of the population. This is because the return data of SIPs do not cover the whole population. Standard deviations have been computed by using the n-1 method, as aforementioned, and presented below.

$$s_{p,t} = \sqrt{\frac{\Sigma\left(wr_{i,t}-\overline{W\ \ p,t}\right)^2}{n_{p,t}-1}}, \tag{33}$$

As in the case of ARs, the statistical significance of WR figures is also denoted with *, **, and ***, indicating significance at levels of 10%, 5%, and 1%, respectively. The conclusion chapter reports both the *p*-values and the t-statistics in the result tables.

Moreover, to ensure the most accurate and sufficient results, the medians have also been reported and calculated with the aim of measuring the central tendency of the data comprehensively. With respect to the research hypotheses, the null hypothesis is that the medians do not differ statistically significantly from 1.00. To test this null hypothesis, the Wilcoxon's (1945) ranked-sum test is utilized, and the *p*-values for medians are also shown in the result tables. Both median and mean tests have been performed under the assumption of independence.

In order to compare the equally-weighted WRs between the Europe, Nordic, and Finland portfolios, an independent Student's two-sample t-test for unequal variances and sample sizes is employed to test whether there is statistical equality of differences in means. In other words, the method tells whether the differences—measured in means—could have happened by chance. For example, if $WR_{p_1,t}$ and $WR_{p_2,t}$ are the mean WRs, respectively, for the Europe and Nordic portfolios, then the Student's two-sample t-statistic for those portfolios can be computed as follows.

$$t = \frac{(WR_{p_1,t} - WR_{p_2,t})}{\sqrt{\left(\frac{s^2_{p_1,t}}{n_{p_1,t}} + \frac{s^2_{p_2,t}}{n_{p_2,t}}\right)}}, \quad (34)$$

where

$s^2_{p,t}$ = the sample variance of the wealth relatives in the portfolio p in period t, calculated by using the n-1 method.

As was done with the ARs, the statistical equality of medians between portfolios has also been tested by utilizing the non-parametric Wilcoxon–Mann–Whitney rank test. In addition, this is similarly done by using the assumption of independence.

7 Empirical results

This chapter presents the descriptive statistics as well as research results obtained in the empirical part of the thesis. The research hypothesis is tested with two market-adjusted methods. Furthermore, as noted previously, the means of both methods are tested by using two different versions of the Student's (1908) t-test. Similarly, the medians for both market-adjusted techniques are tested with two commonly used statistical non-parametric tests.

7.1 Descriptive statistics

As previously noted, the empirical analysis of this study is conducted by using the return data of 39 capital-protected SIPs. The return data for the suitable total return equity indices is used to proxy the market portfolio returns. The SIPs return performance data is from Danske bank, and its prospectus documents partly collected by hand. Index data is obtained from Thomson Reuters.

The HPRs for the SIP portfolios are illustrated in Table 7. From the figures, it is apparent that HPRs are quite close to each other in all portfolios. More precisely, the Europe, Nordic, and Finland portfolios are very similar in terms of HPRs, with means (medians) of 0.23 (0.21), 0.21 (0.20), and 0.22 (0.23), respectively. Thus, according to the mean HPRs, the Europe portfolio is most successful in economic terms. On the other hand, in terms of median HPRs, the most successful portfolio is Finland. The Nordic portfolio is the worst-performing product portfolio in terms of both HPR calculation methods.

As can be seen from Table 7, HPRs are deviating from 0.08 to 0.40. The figures also show that Europe and Finland portfolios have remarkably higher standard deviations (0.10 for both) compared to the Nordic portfolio (0.06). Moreover, the descriptive statistics table also shows that the number of HPR observations for Europe, Nordic, Finland, and All portfolios are 10, 16, 13, and 39, respectively.

Table 7. Descriptive statistics on HPRs for the SIP portfolios.

HPR	Mean	Median	SD.	Min.	Max.	N
Europe	0.23	0.21	0.10	0.08	0.40	10
Nordic	0.21	0.20	0.06	0.11	0.33	16
Finland	0.22	0.23	0.10	0.07	0.38	13
All	0.22	0.21	0.08	0.07	0.40	39

The comparisons are made for all products in the whole sample as well as for the different portfolios by using appropriate stock indices as market indices. The HPRs of these total return stock indices are illustrated in Table 8. At this point, it is particularly worth recalling that—to ensure comparability—the returns of each TRI have been collected from the same time period as the comparable SIP has been on the market. That is the period between the issue date and maturity date of the comparable SIP.

From the figures of Table 8, it is apparent that HPRs of TRIs have not been as close to each other as in the case of SIP portfolios. Moreover, in terms of mean HPRs, Table 8 indicates that OMX Helsinki has had the highest returns (0.66). Moreover, OMX Nordic All-Share has performed a little worse (0.54) than OMX Helsinki, but the performance of Euro Stoxx 50 has been almost twice as poor (0.35) as OMX Helsinki index. The order remains exactly the same with respect to the median HPRs.

It can be seen from Table 8 that these HPRs are also strongly deviated, as the range from 0.18 to 1.11 shows. Thus, the data would seem to suggest that, in general, the standard deviations of the indices are higher than those of the SIPs. Furthermore, the statistics show that OMX Helsinki has more than three times the standard deviation compared to the OMX Nordic All-Share index (0.26 vs. 0.08). Compared to the Euro Stoxx 50 index, OMX Helsinki has twice the standard deviation (0.26 vs. 0.13).

Table 8. Descriptive statistics on HPRs for the TRIs.

HPR	Mean	Median	SD.	Min.	Max.	N
Euro Stoxx 50	0.35	0.32	0.13	0.18	0.54	10
OMX Nordic All-Share	0.54	0.53	0.08	0.42	0.76	16
OMX Helsinki	0.66	0.57	0.26	0.33	1.11	13
Euro Stoxx 50	0.40	0.32	0.17	0.18	0.85	39

7.2 Abnormal returns

The AR is the percentage difference between the HPR on the SIP and the return on the chosen benchmark index in the same time period. In Table 9, all the mean and median ARs are reported separately for the Europe, Nordic, and Finland portfolios as well as for the whole sample of 39 SIPs ("All").

The ARs range from -0.33 to 0.11 for the Europe portfolio, from -0.48 to -0.23 for the Nordic portfolio, and from -0.81 to -0.23 for the Finland portfolio. For all 39 products, the ARs ranged from -0.49 to 0.11. Thus, ARs are quite deviated, as they range totally from -0.81 to 0.11. The statistics also suggest that Europe and Finland portfolios have considerably higher standards deviations as they are 0.13 and 0.18, respectively. The standard deviation of the Nordic portfolio is 0.07. This is logically in line with the descriptive statistics on HPRs for the SIPs in Table 7.

The p-values and t-statistics in the table for the mean ARs have been computed by the Student's (1908) t-test. The t-test for one-sample is used to test if the mean ARs differ significantly from zero, and the t-test for two-sample assuming unequal variances is utilized in order to test the equality of means between the ARs of different product portfolios. This way, the possible statistical differences between the mean ARs of SIPs with different underlying stock indices can be tested.

Table 9. Abnormal returns.

ABNORMAL RETURNS (AR)	Europe	Nordic	Finland	All	E - N	E - F	N - F
Mean	-0.12**	-0.33***	-0.45***	-0.18***	0.21***	0.32***	0.12**
***t*-statistic**	(-2.922)	(-17.850)	(-9.076)	(-7.175)	(4.432)	(4.944)	(2.203)
Mean *p*-value	0.017	0.000	0.000	0.000	0.001	0.000	0.044
Median	-0.13**	-0.31***	-0.44***	-0.16***	0.18***	0.31***	0.13*
Median *p*-value	0.025	0.000	0.002	0.000	0.000	0.000	0.062
Median exact *p*-value	0.020	0.000	0.000	0.000	0.000	0.000	0.062
Median simul. *p*-value	0.019	0.000	0.000	0.000	0.000	0.000	0.061
Min.	-0.33	-0.48	-0.81	-0.49			
Max.	0.11	-0.23	-0.23	0.11			
SD.	0.13	0.07	0.18	0.16			
N	10	16	13	39			

Normal, exact, and simulated *p*-values (based on 10 000 samples) for the median ARs have been obtained by the two commonly used non-parametric statistical methods. Both ties corrections and continuity corrections are used, but it should be noted that these correction methods only apply to the normal approximation. In other words, these two corrections do not apply to the exact and simulated versions of the non-parametric tests.

The Wilcoxon's (1945) ranked-sum test is employed to test whether the median ARs differ significantly from zero, and the Wilcoxon–Mann–Whitney rank test is utilized in order to test the equality of medians between the ARs of different SIP portfolios. By using this procedure, the possible statistical differences between the median ARs of SIPs with different underlying stock indices can be tested.

According to the statistics, the Europe, Nordic, and Finland portfolios—as well as the whole sample—have been statistically significantly and economically overpriced on average. Mean (median) AR of Europe portfolio is -0.12 (-0.13) at the 5% level of significance. Furthermore, mean (median) ARs for the Nordic, Finland, and All portfolios have been -0.33 (-0.31), -0.45 (-0.44), and -0.18 (-0.16) at the 1% level of significance, respectively. Hence, the null hypothesis can be rejected, as it is quite clear that both the means and medians differ from zero.

In addition, it can be seen that both mean (-0.12) and median (-0.13) ARs are considerably higher for the Europe portfolio. However, the mean and median ARs of all portfolios are quite far away from zero. Thus, the data would also seem to indicate that, in terms of means and medians, SIPs are incapable of generating positive ARs.

Another interest in Table 9 is the comparison of the ARs between the SIP portfolios. As can be seen from the table, the difference in means (medians) between Europe and Nordic, Europe and Finland, and Nordic and Finland portfolios are 0.21 (0.18), 0.32 (0.31), and 0.12 (0.13), respectively. Therefore, the data would seem to suggest that the mean and median ARs of the Europe portfolio are different from those of other SIP portfolios. In addition, because of the mathematical difference between the Europe portfolio and the comparable portfolio is positive in both cases, the data indicates that the Europe portfolio performs better than the Nordic and Finland portfolios in the whole sample.

Furthermore, differences in both means and medians between Europe and Nordic, as well as the Europe and Finland portfolios, have been statistically significant at a 1% level. This significance indicates strong evidence of the superior AR performance of the Europe portfolio when compared to the Nordic and Finland portfolios. The difference in mean (median) ARs between the Nordic and Finland portfolios have been statistically significant at a 5% (10%) level, which suggests that the AR performance of the Nordic portfolio has been better than that of the Finland portfolio.

Finally, overall, the performance of SIPs has been undoubtedly weak, with all mean and median ARs being negative. There is enough evidence to infer that the ARs are significantly below zero. Thus, capital-protected SIPs, whose underlying asset is tracking European, Nordic, or Finnish stocks, appear to underperform the market portfolio.

7.3 Wealth relatives

The wealth relative (WR) is a performance measure, which is utilized to measure market-adjusted SIP returns in the five-year period. A WR with a greater value than 1.00 is interpreted as the SIP outperforming the equity market index, and vice versa.

Table 10 presents the statistics for the mean and median WRs separately for the Europe, Nordic, and Finland portfolios as well as for the complete sample of 39 SIPs ("All"). The statistics show that the WRs range from 0.76 to 1.09 for the Europe portfolio, from 0.70 to 0.84 for the Nordic portfolio, and from 0.62 to 0.83 for the Finland portfolio. For all 39 products, the range is from 0.71 to 1.09. Thus, all the WRs range from 0.62 to 1.09. The statistics also show that the standard deviation for Europe, Nordic, Finland, and All portfolios are 0.10, 0.04, 0.06, and 0.10, respectively.

Table 10. Wealth relatives.

WEALTH RELATIVES (WR)	Europe	Nordic	Finland	All	E - N	E - F	N - F
Mean	0.91**	0.79***	0.74***	0.88***	0.13***	0.17***	0.05**
***t*-statistic**	-2.825	-20.984	-14.505	-7.665	3.960	4.887	2.210
Mean *p*-value	0.020	0.000	0.000	0.000	0.002	0.000	0.040
Median	0.91**	0.79***	0.72***	0.89***	0.12***	0.19***	0.07**
Median *p*-value	0.041	0.000	0.002	0.000	0.001	0.000	0.046
Median exact *p*-value	0.037	0.000	0.000	0.000	0.000	0.000	0.045
Median simul. *p*-value	0.038	0.000	0.000	0.000	0.000	0.000	0.044
Min.	0.76	0.70	0.62	0.71			
Max.	1.09	0.84	0.83	1.09			
SD.	0.10	0.04	0.06	0.10			
N	10	16	13	39			

Statistically speaking, the *p*-values and *t*-statistics in the table for the mean WRs have been computed by the Student's (1908) *t*-test. The *t*-test for one-sample is applied to test if the mean WRs differ significantly from 1.00, and the *t*-test for two-sample assuming unequal variances is utilized in order to test the equality of means between the WRs of different SIP portfolios. Thus, the possible statistical differences between the mean ARs of SIPs with different underlying stock indices can be tested.

Normal, exact, and simulated *p*-values (based on 10 000 iterations) for the median WRs have been obtained by the two non-parametric statistical methods. Both ties corrections and continuity corrections are used, but it should be pointed out that these correction methods only apply to the normal approximation. Alternatively stated, these two corrections do not apply to the exact and simulated versions of the non-parametric tests.

The Wilcoxon's (1945) ranked-sum test is applied to test whether the median WRs differ significantly from 1.00, and the Wilcoxon–Mann–Whitney rank test is employed in order to test the equality of medians between the WRs of different product portfolios. By using this method, the possible differences between the median WRs of a different kinds of SIPs can be statistically tested.

As can be noted from Table 10, all the WRs are statistically significantly different from 1.00 for any of the four SIP portfolios. The statistics show that Europe, Nordic, Finland, and All portfolios have been significantly and economically overpriced on average. The mean and median WRs of the Europe portfolio are both 0.91 at the 5% level of significance. Furthermore, mean (median) WRs for the Nordic, Finland, and All portfolios have been respectively 0.79 (0.79), 0.74 (0.74), and 0.88 (0.89) at the 1% level of significance. Thus, the null hypothesis can be safely rejected, as it is quite clear that both the means and medians differ from 1.00.

In addition, as can be seen from Table 10, both mean (-0.91) and median (-0.91) WRs are remarkably higher for the Europe portfolio. However, the mean and median WRs of all portfolios are quite far away from 1.00. Hence, the results of the present study demonstrate that in terms of means and medians, SIPs will not be able to beat the passive index investing.

Table 10 also shows that the difference in means (medians) between Europe and Nordic, Europe and Finland, and Nordic and Finland portfolios are 0.13 (0.12), 0.17 (0.19), and 0.05 (0.07), respectively. Therefore, the statistical data seems to suggest that the mean and median WRs of the Europe portfolio are different from those of other SIP portfolios whose underlying assets are tracking stocks from Finland and Nordic countries. Furthermore, because of the mathematical difference between the Europe portfolio and the comparable portfolio is positive in both cases, the data seems to indicate that the Europe portfolio performs economically better than the Nordic and Finland portfolios in the whole sample. That is to say, the positive difference in the WRs between the portfolios indicates that the Europe portfolio may have higher returns.

Moreover, differences in both mean and median WRs between Europe and Nordic, as well as the Europe and Finland portfolios, have been statistically highly significant at a 1% level. This significance indicates a shred of strong evidence that the Europe portfolio performs significantly better than other product portfolios when compared to the equity market index. The difference in mean and median WRs between the Nordic and Finland portfolios have been statistically significant at a 5% level, which suggests that the AR performance of the Nordic portfolio has been better than that of the Finland portfolio.

Finally, taking into account the statistical data, we can surmise that the performance of SIPs has been undoubtedly weak, with all mean and median WRs being significantly under 1.00. This finding suggests that passive index investing may outperform the SIPs in this sample. Regarding the performance differences between Europe, Nordic, and Finland portfolios, it can be seen from Table 10 that all the portfolios statistically significantly underperform the market index.

8 Conclusions

The question, whether the returns on passive index investments differ from the returns on capital-protected SIPs has been preoccupying the financial experts for some time. This thesis examines SIPs and their ability to provide long-run returns for investors by utilizing statistical market-adjusted methods. The research sample includes data covering 39 SIPs issued and expired in Finland between the years 2010 and 2019. These products are further classified into Europe, Nordic, Finland, and All portfolios.

SIP is, by definition, a combination of two or more financial instruments whose return is determined in the basis of a performance of the underlying asset (Das, 2005; Järvinen & Parviainen, 2014; Yen & Lai, 2014; Jessen & Jørgensen, 2012.) The thesis has comprehensively explored the theory of bond-style capital-protected investments and attempted to answer the question of whether to invest in these five-year SIPs or not. However, this dilemma is not as clear to explain as one might think.

The analysis is motivated by the fact that despite the decades-long existence of SIPs, the performance of these products has not been studied widely up to date. This thesis aims to fill in an area of knowledge by examining something that has not been extensively studied. This study seeks to provide new information about the Finnish markets of SIPs. The thesis is also motivated by the author's own desire to understand the complexity of SIPs and by the prior literature, which indicates that the SIPs are underperforming the market index in the long run.

The implications of this research are manifold. Firstly, performance results are critical because they show that SIPs—in the research sample—are undeniably weak five-year investments, with mean and median ARs (WRs) for all portfolios being significantly under zero (1.00). This finding is consistent with Entrop's et al. (2014) contention that the performance of SIPs is weaker than in the market as a whole.

Secondly, it is important to understand that the performance of fully capital-protected products varies remarkably over time. Due to their capital-protecting properties, these products can be reasonably good investment choices, for example, in the situation of crisis. In contrast, the empirical part of this study shows that as the market rises, fully capital-protected products tend to have considerably lower returns. This is also in line with other studies comparing SIPs to market returns.

Thirdly, SIPs allow investors to invest in underlying assets that may otherwise be too expensive or even impossible to reach (Das, 2005). According to Järvinen & Parviainen (2014), SIPs may often be the first investment instrument for a retail investor to enter into the new markets. Furthermore, SIPs are designed to provide investors with access to complex option and futures positions without the need to enter those markets directly. Due to high fee and transaction costs, direct participation in the options and futures markets may be disadvantageous or even impossible for most investors. For this reason, SIPs can generally be said to provide a useful extension to the private investor's capital market. This extension may also create diversification benefits and limit exposure to risks.

Fourthly, due to the unique characteristics, SIPs can meet the diverse needs of different types of investors as they can build a myriad of different return and risk profiles. SIPs are created with—inter alia—different maturities, underlying assets, and risk profiles (Järvinen & Parviainen, 2014, p. 29). Studies also show that investors with mental accounting bias can use SIPs to improve the allocation of their portfolios. By combining this bias with the prospect theory framework, an investor can be said to define returns on investment on the basis of a reference price, which is separately set for each mental account according to the mental accounting bias.

From a perspective of capital-protected investments, an investor's investment portfolio may consist of smaller mental accounts associated with different objectives. Through these objectives or goals, mental accounts are optimized separately by looking for appropriate allocations and investments for the goals that individually maximize the expected return for each mental account. With the main goal being, for example, maintaining capital for retirement, a truly optimal portfolio for a risk-averse investor may consist of time deposits and capital-protected products. The fully capital-protected SIPs with theoretically unlimited return potential and effectively limited risk may simultaneously constitute an attractive and—according to the prospect theory framework—an optimal investment option.

Based on the prospect theory and other investor heuristics, it can be stated that the majority of retail investors making savings and investments belong to the group of people who experience investment losses and gains asymmetrically in their utility function. For such a risk-averse investment profile, where the utility function is nonlinear, a capital-protected product may be optimal. Capital-protecting investors who protect their invested principal amounts are less likely to beat index investors when underlying market developments are positive. However, a greater amount of satisfaction may be gained from capital-protected investing as it quite effectively limits the risks and creates virtually limitless return potential.

It is now clear that the utility gain can be sizable and that there are possible rational explanations for the investor demand for SIPs. Let us now turn our attention to the more detailed conclusion of the empirical results of this study. In contrast to the return performance of passive index investing, the empirical results of this study show that capital-protected SIPs perform statistically significantly poorly. The findings of the empirical part of the thesis demonstrate that capital-protected SIPs, issued in Finland, are statistically significantly overpriced with a mean (median) five-year HPRs of 0.22 (0.21).

Taking into account the statistical data, we can surmise that capital-protected products with underlying assets tracking European, Nordic, and Finnish stocks are economically and statistically unable to generate positive ARs. Hence, the difference between the HPR on SIP and the HPR on a market portfolio is, on average, highly significantly below zero. This negative difference suggests the underperformance of SIPs when compared to the market portfolio.

Moreover, the statistics show that both mean and median WRs of capital-protected products whose price is depending on European, Nordic, and Finnish stocks are significantly under 1.00. Thus, the empirical results demonstrate that capital-protected SIPs are unable to outperform passive index investing. The research results of the study further demonstrate that the Europe portfolio of SIPs is outperforming the Nordic and Finland portfolios. Furthermore, the Europe portfolio has significantly higher ARs in the five-year period. However, this abnormal outperformance can be partly explained by the relatively lower HPRs of the Euro Stoxx 50 TRI (see subchapter 7.1.).

Differences in both ARs and WRs between Europe and Nordic, Europe and Finland, and Nordic and Finland portfolios are positive. This finding suggests that the portfolio with SIPs whose underlying asset tracks the European stocks performs better than the Nordic and Finland portfolios. The difference in mean (median) ARs between Nordic and Finland portfolios are positive and significant at 5% (10%) level. This statistically significant difference indicates quite strong evidence of higher ARs on the Nordic portfolio compared to the Finland portfolio.

Similarly, the positive difference in WRs between the portfolios indicates that the Europe portfolio may have higher returns than other SIP portfolios when compared to the market portfolio. Also, the difference in mean and median WRs between Nordic and Finland portfolios have been statistically significant at a 5% level, which suggests that the AR return performance of the Nordic portfolio has been better than that of the Finland portfolio.

Overall, the empirical research results reported in the thesis indicate that the Europe portfolio provides significantly higher long-run returns than Nordic and Finland portfolios in the five-year period. Despite this fact, research findings suggest that SIPs are generally weak 5-year investments. These findings are consistent with Grünbichler's and Wohlwend's (2005), Stoimenov's and Wilkens's (2005), Das's and Statman's (2013), and

Abreu's and Mendes's (2018) contention that SIPs are poor long-run investments**.** Moreover, although the performance of SIPs in the Europe portfolio is moderately poor, the underperformance—measured in ARs and WRs—in the whole sample is mostly attributable to SIPs in the Nordic and Finland portfolios.

Finally, taking into account the statistical data, it can be surmised that the performance of SIPs has been undoubtedly weak, with all mean and median ARs being negative. This same weakness is also reflected in the WRs that have been significantly under 1.00. Thus, SIPs tracking the European, Nordic, or Finnish stocks appear to underperform when compared to the market index. This finding suggests that returns on passive index investing may outperform the returns on fully capital-protected SIPs. This result is consistent with the previous literature, which states SIPs tend to be overpriced and favored by the issuer (Wohlwend, Burth & Kraus, 2001; Wohlwend & Grünbichler, 2003; Grünbichler & Wohlwend, 2005; Stoimenov & Wilkens, 2005; Szymanowska, Horst & Veld, 2009; Das & Statman 2013; and Abreu & Mendes, 2018).

One of the main differences between index investing and investing in fully capital-protected SIPs is that the latter protects the capital investments of investors. It is true that the utility gain can be sizable and that there are some rational explanations for the investor demand for SIPs, yet the fact remains that—according to purely performance measures—the cost of complexity and capital-protection usually outweighs the benefits.

Based on the topic of this thesis, further research could be related to the sum of the costs of issuing SIPs, such as hedging costs and the cost of issuing ZCBs. The subject is very interesting because if the sum of these costs is lower than the prices of SIPs, it could be possible for the issuer to actually use SIPs to raise cheaper capital. For example, the number of SIPs offered by Lehman Brothers increased drastically in connection with the increase in the credit risk of that bank in 2007–2008. Behavior such as this could potentially lead to the conclusion that the complexity of products and the resulting lack of understanding on the part of investors can have a tremendous impact on the market.

Another perspective of the same topic could be that the high premiums are explained by the total issuing costs incurred by the issuer. In addition to the above, costs are also arising from providing a liquid market for the SIPs. This is typically the responsibility of the issuer. Because of these costs reasons, the issuer's profitability cannot be adequately assessed without additional information on hedging costs and other bank-specific costs associated with issuing SIPs. However, obtaining such information is challenging since all the cost information is hardly available to the public as it is often not in the interest of the bank to disclose such data.

As previously noted in the study, one possible flaw in the market-adjusted methodology is that the return time periods of individual SIPs may overlap. Thus, the assumption of independence in the mean and median tests may not hold accordingly. This flaw may cause distortions in statistical significance. However, if one would be able to gather an acceptable amount of price data, the *calendar-time methodology* could be utilized. This risk-adjusted methodology could control for the problems of *cross-correlation* and *event-clustering* in SIPs returns as it uses rolling time portfolios. Once all SIPs are classified as indicated by the calendar-time methodology, *time-series regressions* could be run separately for equally-weighted monthly portfolios starting with the basic one-factor CAPM. For example, portfolios could be built in the same manner as Europe, Nordic, Finland, and All portfolios in this study.

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